MAY 26 1910

JOURNAL OF ELECTRICITY

POWER AND GAS

Devoted to the Conversion, Transmission and Distribution of Energy

Entered as second-class matter May 7, 1906, at the Post Office at San Francisco, Cal., under the Act of Congress March 3, 1879

VOL. XXIV NO. 21 | SAN FRANCISCO, MAY 21, 1910 | PER COPY, 10 CENTS

Henshaw, Bulkley & Co.

ENGINEERS

Machinery Merchants

San Francisco: 19 - 21 Fremont Street
Los Angeles: 262 So. Los Angeles St.
Oakland: 1436 Fifth St.

OKONITE WIRE

OKONITE
TRADE MARK
REG. U.S PATENT OFFICE.

The STANDARD for RUBBER INSULATION

Okonite Tape, Manson Tape,
Candee Weatherproof Wire,
Candee (Patented) Potheads.

The Okonite Company

253 BROADWAY, NEW YORK

CENTRAL ELECTRIC CO., Chicago, Ill. F. D. LAWRENCE ELECTRIC CO., Cincinnati, O.
NOVELTY ELECTRIC CO., Philadelphia, Pa. PETTINGELL-ANDREWS CO., Boston, Mass.
ROBBINS ELECTRIC CO., Pittsburg, Pa.

PARANITE

INDIANA RUBBER AND INSULATED WIRE CO.

Manufacturers of Paranite and Peerless Rubber Covered Wires and Cables
Underground Aerial, Submarine and Inside Use
Telephone, Telegraph and Fire Alarm Cables
All Wires are Tested at Factory JONESBORO, IND.

Electric Appliance Company

728 Mission St., San Francisco — Pacific Coast Agents

Standard Underground Cable Co.

MANUFACTURERS OF

COPPER WIRES, CABLES AND ACCESSORIES

FOR ALL SERVICES

PACIFIC COAST DEPT. First National Bank Building, San Francisco
Sub-Office—Los Angeles, Cal.
GENERAL OFFICES: PITTSBURG, PA.
Factories Oakland, Cal., Pittsburg, Pa., Perth Amboy, N. J.
Branch Offices: New York, Boston, Chicago, Philadelphia, St. Louis

Phillips Insulated Wire Co.

PAWTUCKET, R. I.

INSULATED WIRE O.K. AND CABLES

"O.K." WEATHERPROOF
"PARAC" RUBBER COVERED

BLACK CORE PARAC RUBBER WIRES

COMPLETE STOCKS CARRIED BY
OUR PACIFIC COAST AGENTS

California Electric Co. LOS ANGELES — Electric Appliance Co. SAN FRANCISCO — Western Electric Co. SEATTLE

Specify....

BROOKFIELD GLASS INSULATORS

The Standard

PACIFIC METER CO.

MANUFACTURERS OF

Wet and Dry Gas Meters, Station Meters, Provers, Gauges, Etc.

311 SANTA MARINA BUILDING
California and Drumm Sts. — San Francisco

VULCAN ..... Refrigerating and Ice Making Machinery

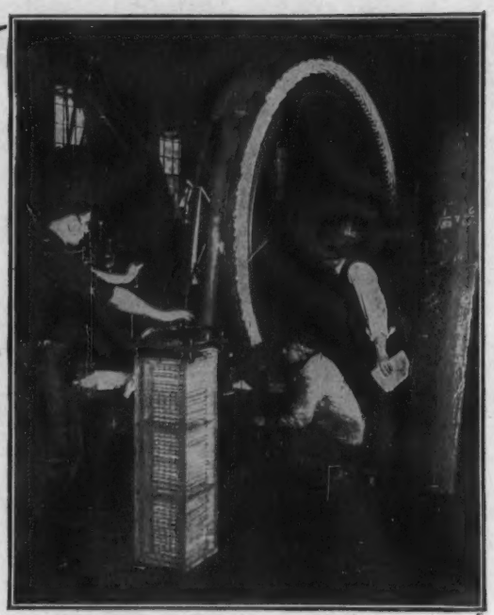
MANUFACTURED BY

VULCAN IRON WORKS

Office: 702 Atlas Bldg., 604 Mission St.
Works: Francisco and Kearny Streets — San Francisco

FOR INDEX TO ADVERTISEMENTS SEE PAGE EIGHT

What Our Factory Tests Mean To The Purchaser



Every machine we make is set up and subjected to tests much more severe than those they will encounter in actual service.

This work is done by experts who try to develop faults instead of "nursing" the machine to secure a fine performance.

Every detail is carefully tabulated and if the temperature rises too high; if it delevops too much speed or fails to deliver the proper voltage and output, it goes back in the factory and these faults are absolutely corrected.

Our name never goes on an Alternator until it has successfully passed these tests and it is the best guarantee you can get that the machine will take up its work from the start and not "go wrong" the first time your conditions vary a little.

We make alternators of all sizes for any kind of work and it will pay you to send for our several Bulletins on the subject before you decide on what kind to buy.

FORT WAYNE ELECTRIC WORKS, FORT WAYNE, IND.

San Francisco Office: 403 Atlas Building

"Wood Systems"

Seattle Office: 223 Colman Building

A4

BENJAMIN PLUG CLUSTER

Cat. No. 92

Gives you ***Two Outlets where you have but One.***

Doubles the Capacity of your Sockets ***by doing the Work of Two.***

10,000,000
Advertisements now running in
Saturday Evening Post
Electric Journals, Etc.

Does your Customer want ***two Lights where he has but one,*** or would he like ***to attach a Fan, Portable Lamp, Chafing Dish, Curling Iron, Flat Iron, Motor-run Machine, and*** be able to ***burn a light at the same time?***

You need only to screw our "2-in-1" Plug into the Socket.

It Requires no Wiring—Is Small in Size—It Can't Wear Out

Write for Descriptive Circular and Discounts

List Price $1.00

BENJAMIN ELECTRIC MFG. CO.

NEW YORK
27 Thames St.

SAN FRANCISCO
151 New Montgomery St.

CHICAGO
120-128 S. Sangamon St.

B 213 507

JOURNAL OF ELECTRICITY
POWER AND GAS
Devoted to the Conversion, Transmission and Distribution of Energy

VOLUME XXIV SAN FRANCISCO, MAY 21, 1910. NUMBER 21

[Copyright 1910, by Technical Publishing Company]

ARCHED DAMS

BY L. R. JORGENSEN.

The usual practice in curved dam construction is to span the canyon with one continuous arch. For spans less than 600 ft. a curved dam of this type requires less material for the same factor of safety than a straight gravity dam (Wegmann section). If the gap to be closed is over 600 ft. wide, the cross sectional area of the arch becomes nearly as great as the cross sectional area of a gravity dam for equal stresses, and when it is considered that the arch is always longer than the chord, it is evident that the limit of economy for a single arch span has been reached, if special conditions are not present. Recently the multiple arch type of dam has come into existence and given promise of allowing big reductions in the quantity of material required for structures safely spanning gaps of any width.

Completed Multiple Arch Dam at Hume, California.

The Hume Lake dam near Fresno, California ("Journal of Electricity, Power and Gas," October 30, 1909, December 25, 1909, February 12, 1910), designed and constructed by Mr. J. S. Eastwood, is the first

example of this kind of structure in the United States, and Mr. Eastwood is to be congratulated upon successfully carrying out this work "without precedent."

In the following, comparisons are made between different types of arched dams for the same sites. All dams are calculated for 125 ft. height. Fig. 1 shows a section to be used for a 200-ft. span. The thrust is taken up partly by arch action and partly by gravity action, and it was decided to design the section in such a way that the line of pressure, reservoir full, due to the portion of load taken up by gravity action, should cut the base inside the section. This condition gives the profile a factor of safety against overturning of at least 1 due to gravity alone. Before the proportions of thrust taken respectively by gravity and arch action can be found, the radius of curvature must be decided upon. As the thickness of the masonry varies directly with the radius of curvature, the area of the cross section and the content of the dam must also vary proportionately to variations in the length of the radius. The content of any curved dam = 2 x mean radius x enclosed angle x area of cross section; and will for practical profiles be found to be a minimum, when the enclosed angle is about 120 degrees. The exact value will depend upon the shape of the canyon and the top thickness adopted.

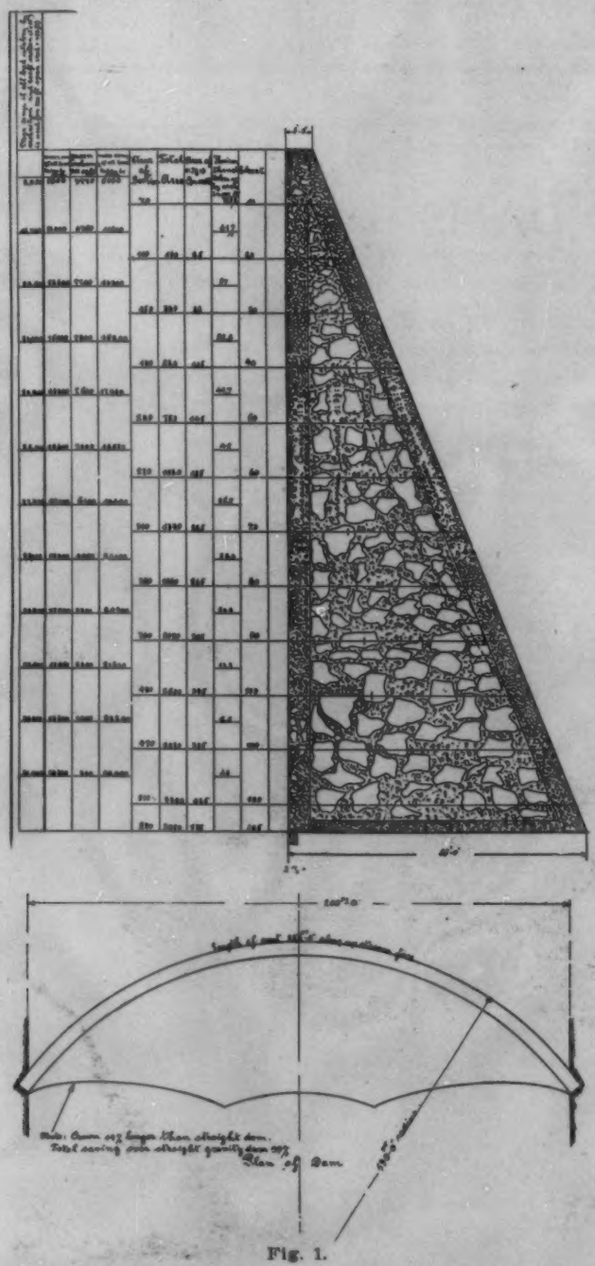


Fig. 1.

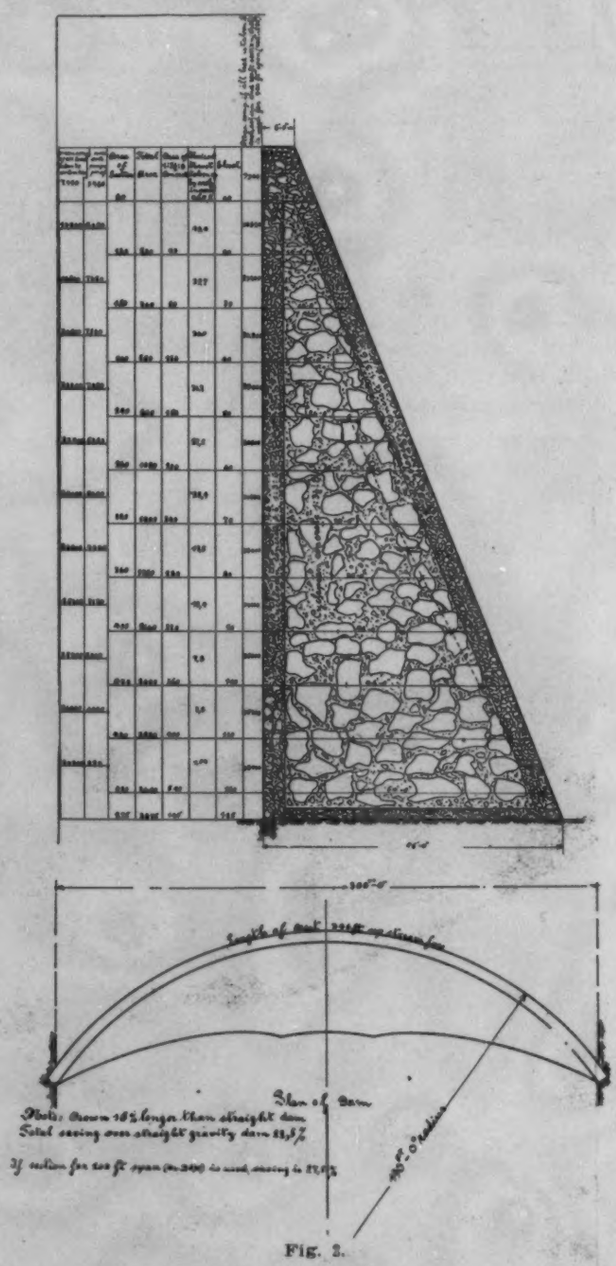


Fig. 2.

For the section shown in Fig. 1 a smaller angle and a correspondingly larger radius (130 ft.) was used in order to load the material which had to be there in order to satisfy the first condition of keeping the line of pressure, reservoir full, within the section.

The percentages of the horizontal thrust of the water taken up by arch action at different elevations were computed from formulas given in discussions on the paper "Lake Cheeseman Dam and Reservoir," especially from one developed by Mr. R. Shirreff

(Trans. A. S. C. E., Volume LIII). They are too lengthy to be given here. The remainder of the thrust is taken up by gravity action. From tables accompanying Fig. 1 this portion is seen to be the smallest at the top and increasing towards the foundation, or, on the other hand, the thinner the arch ring is, the more thrust is taken up by arch action. A calculation was also made to find the unit stresses assuming all the load carried by the arch action, as this is the most

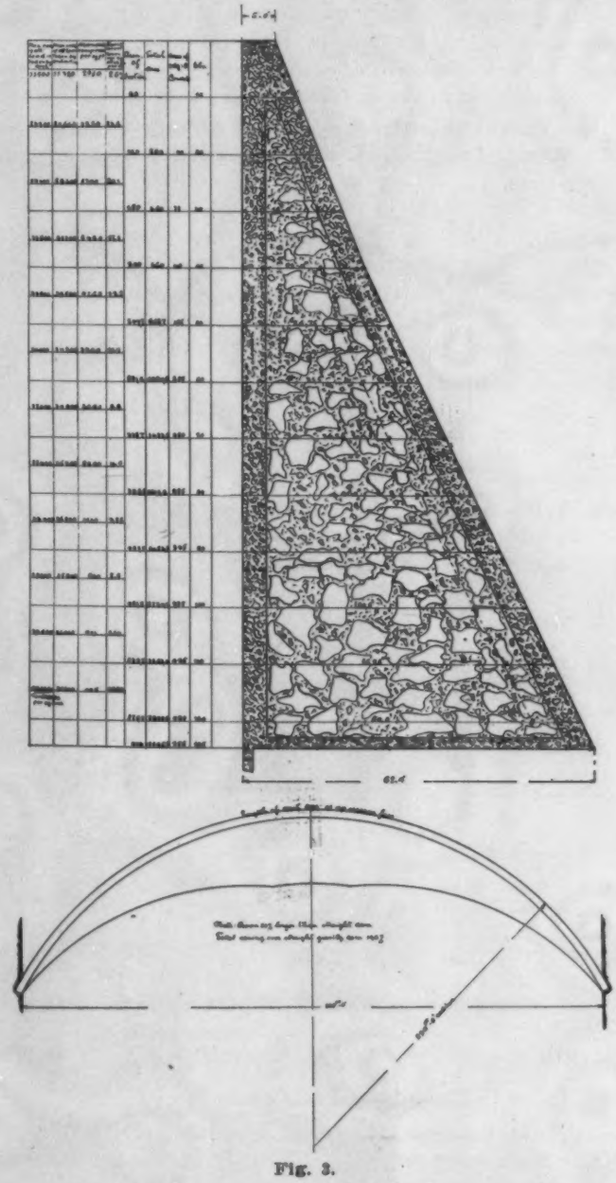


Fig. 3.

severe condition possible. The results are given in tables accompanying Fig. 1, where mean stresses and maximum stresses (compression in lbs. per sq. ft.) are found for elevations spaced at intervals of 10 ft. The mean stresses were found from the usual equation:

$$P \times R = X \times L,$$

where P is the water pressure per sq. ft. at the joint considered, R = up-stream radius, L = length of joint, and X = mean compression per sq. ft. of material. Assuming that the intensity of the stress varies uniformly from the up-stream face to the down-stream face of the arch, the maximum unit compression is found from

$$\frac{\text{maximum compression}}{\text{mean compression}} = \frac{2R}{R + r}$$

where r = radius of down-stream face of dam at joint under consideration.

Take, for example, an arch ring at elevation 115 ft. 1 ft. high. P = 62.5 x 115 (62.5 = weight of 1 cu. ft.

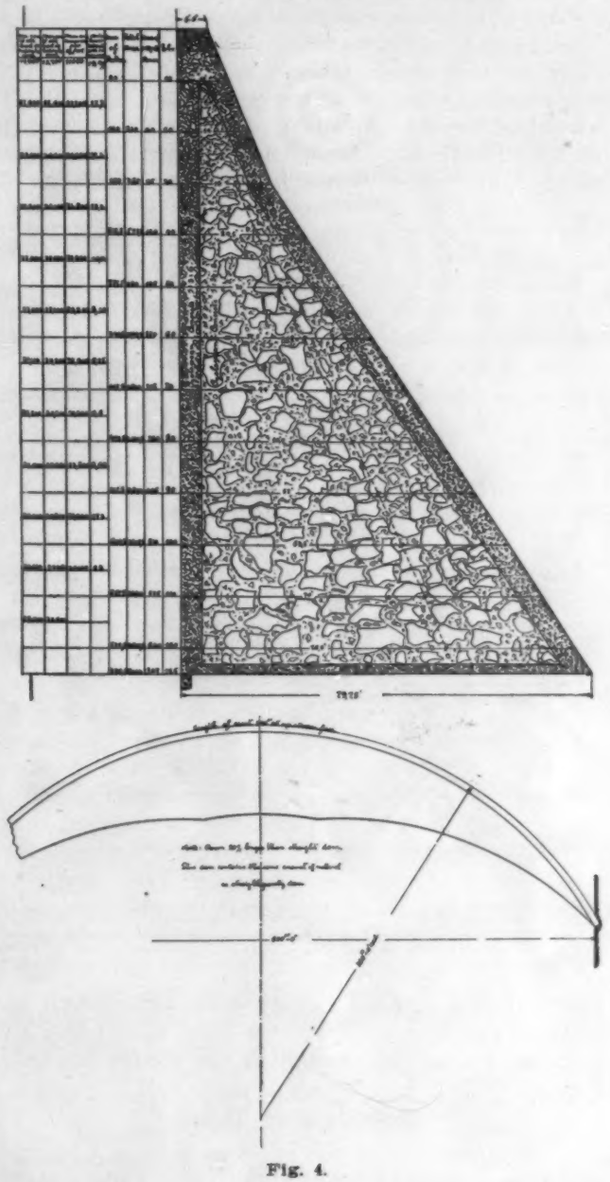


Fig. 4.

of water); R = 130; L = 51. The mean compression

$$= \frac{62.5 \times 115 \times 130}{51} = 18{,}320 \text{ lbs. per sq. ft.}$$

and the maximum compression

$$\frac{2 \times 130}{130 + (130 - 51)} 18{,}320 = 22{,}800 \text{ lbs. per sq. ft.}$$

This unit compression is probably the highest that could be developed anywhere in the section. Going to lower elevations will bring us so close to the foundation that the arch action cannot be developed and some of the load is taken up by shear action.

The above maximum unit compression is very low, but cannot be increased if the section shall be big enough to allow the line of pressure, reservoir full, to fall within the section.

Fig. 2 shows a section designed to be used for a span of 300 ft. Fig. 3 shows a section intended for spans from 400 to 500 ft., and Fig. 4 shows a section intended for a 600-ft. span. Above this limit arch dams of this type are not economical. All profiles are calculated in the same manner as the one shown in Fig. 1. The limiting conditions being that the line of pressure, reservoir full, should fall inside the section, and that the maximum unit compression in no case should exceed 40,000 lbs. per sq. ft., considering the arch to take all the thrust. It is believed that the resulting sections are conservative, have a higher factor of safety than a straight gravity dam, and contain less material (percentages given on Figs. 1, 2, 3 and 4 in each case) than this, except in the section shown in Fig. 4.

The maximum unit compression will be larger and in proportion to

$$\frac{2\,R}{R+(R-L)}=\frac{64}{57}$$

hence, maximum compression $=\frac{64}{57}\times 34{,}300 = 35{,}000$ lbs. per sq. ft.

The dimensions of the buttresses are also adopted after some preliminary calculation to be 2 ft. x 7 ft. at the top and 7 ft. x 132 ft. at the foundation.

All information necessary to determine the points of application of the different forces is now at hand.

Content of buttress = Area x average thickness = 8250 x 1/3 (2 x 7 + 2) = 44,000 cu. ft. = 1630 yds. = 3190 tons.

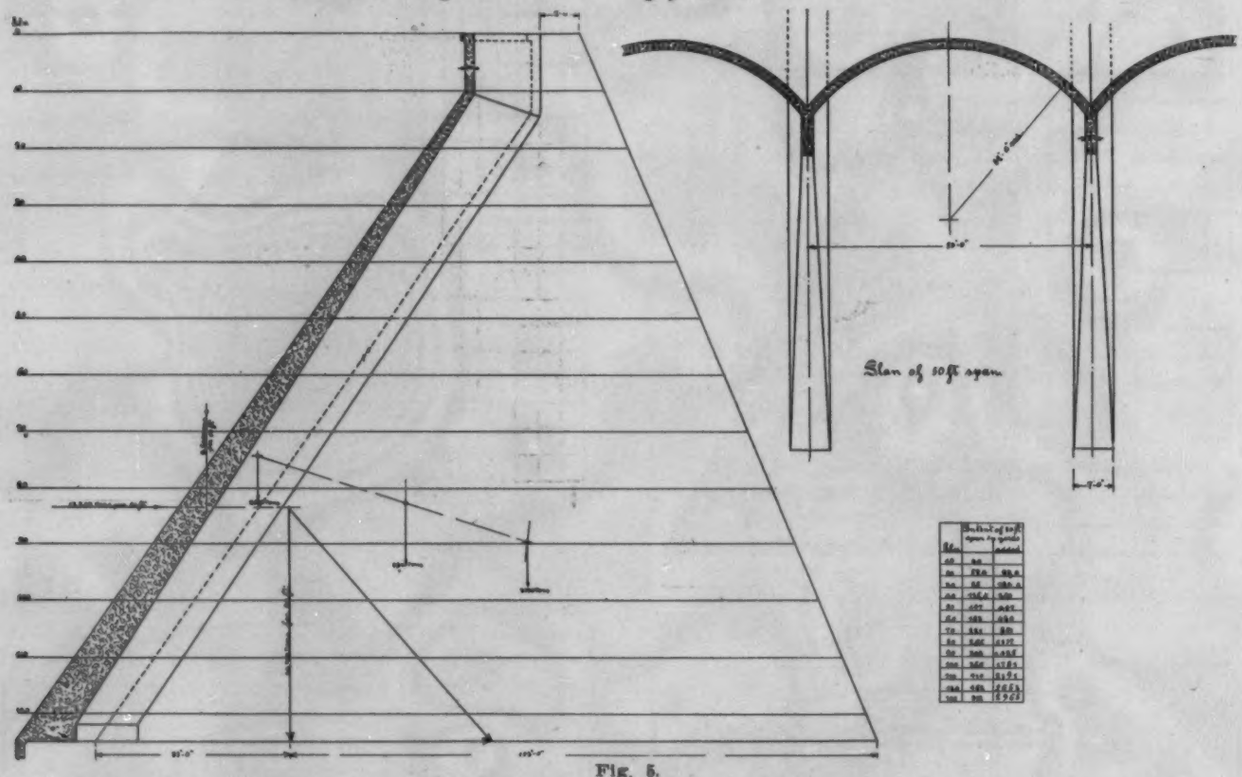


Fig. 5.

Multiple Arch Dams.

Fig. 5 shows a section and plan view of a multiple arch dam, designed for a height of 125 ft. and a distance of 50 ft. center to center of buttresses. After some preliminary calculation, the radius of the extrados is chosen 32 ft. and the slope of the up-stream face 55 degrees, except the upper 10 ft. The top thickness is taken at 18 in. and is carried down to 10 ft. depth, from here to the bottom of the reservoir the thickness is increased uniformly just enough to insure watertightness. At 120 ft. depth the thickness of the arch is 7 ft. The mean unit compression at this depth, therefore, becomes (using the same formula as before):

$$X=\frac{62.5\times 120\times 32}{7}=34{,}300 \text{ lbs. per sq. ft.}$$

where R = 32; L = 7; P = 62.5 x 120.

Content of arch = area of cross section x average length of arch $=4.5\times 150\times \pi\times 59.5\times\frac{103}{360}=36{,}050$ cu. ft. = 1335 yards = 2,620 tons.

Total content 2965 equal approximately 3000 yds. for a 50-ft. section.

The center of gravity of the pier lies on its center line, a distance of

$$\frac{125}{2}\times\frac{7+2}{2\times 7+2}$$

= 35.1 ft. above the foundation.

The center of gravity of the arch cross section is found; then the center of gravity of the whole arch will lie on the radius to the point approximately one-third the height of the arc inside the center of gravity of the arch cross section.

The horizontal distance between the center of gravity of pier and arch is 47.5 ft. and the combined

center of gravity will, therefore, be a distance y from the center of gravity of pier found from

$$2620 \times 47.5 = y\,(2620 + 3190)$$

$$y = \frac{2620 \times 47.5}{2620 + 3190} = 21.4 \text{ ft.}$$

The vertical component of the water pressure acting on the sloping up-stream face will act as weight and the point of application (or at least the plane of application) of the combined weight of the dam and the vertical component of the water pressure must be found:

The vertical component of the water pressure amounts to $115 \times \text{tg } 35 \frac{7812 + 625}{2} = 340{,}000$ lbs. = 170 tons per running ft., or 50 x 170 = 8500 tons per 50 ft. section.

The horizontal distance between point of application of vertical component water pressure and center of gravity of dam = 35 ft., then distance y_2 between center of gravity of dam and center of total vertical forces found from $8500 \times 35 = y_2\,(8500 + 5810)$: $y_2 = \frac{8500 \times 35}{8500 + 5810} = 20.8$ ft.

The resultant of the total vertical forces cuts the base 35 ft. from the up-stream end of the buttress and, as the total length of the base, including thickness of arch, is 138 ft., it is seen (measured on drawing) that the point of intersection is $\frac{138}{3} - 35 = 11$ ft. outside the middle third.

The compression per sq. ft. at the up-stream edge of the pier follows from

$$g = \frac{2W}{L}\left(1 + \frac{\frac{L}{3} - u}{\left(\frac{L}{3}\right)}\right)$$

where L = 138 ft., u = 35 ft., W = 8,500 + 5,810 = 14,300 tons, $g = \frac{2 \times 14{,}300}{138}\left(1 + \frac{11}{46}\right) = 257$ tons per 50 ft., or 5.14 tons per running ft.

The compression per sq. ft. at the down-stream edge of the pier follows from

$$\eta = \frac{2W}{L} - g = 207 - 257 = -50 \text{ tons per 50 ft.,}$$

or — 1 ton per running ft.

This negative compression or tension never takes place, as is easily seen, when the action of the horizontal component of the water pressure is also taken into consideration, but this negative compression helps to compensate for the positive compression due to the action of the horizontal component, making it possible to keep the buttress nearly uniformly loaded from heel to toe.

This is a distinct feature of the sloping face and the large saving in material possible with this type of dam is to a great extent due to the fact that the buttress is nearly uniformly loaded from heel to toe with reservoir full.

The value of the horizontal component of the water pressure per running ft. is found from

$$62.5 \times \frac{125^2}{2} = 488{,}280 \text{ lbs.} = 244.14 \text{ tons.}$$

The point of application of this force is $\frac{125}{3} = 41.66$ ft. above the foundation and its moment around any point in the foundation at elevation 125 is for a 50-ft. span

$$41.66 \times 244.14 \times 50 = 509{,}000 \text{ lbs.}$$

$$\text{Moment of inertia of base} = \frac{b \times L^3}{6} = \frac{50 \times 138^3}{6} = 158{,}700.$$

The stress in the material at the toe and heel due to the turning moment of the horizontal component of the water pressure will then follow from

$$\frac{\text{Bending moment}}{\text{Moment of inertia}} = \frac{509{,}000}{158{,}700} = 3.21 \text{ tons.}$$

The resultant compression of the toe due to weight of structure and to vertical and horizontal component of water pressure is then: 3.21 — 1 = 2.21 tons per running ft. As the buttress is 7 ft. wide at the base, the compression per sq. ft. become $2.21 \frac{50}{7} = 15.8$ tons.

The resultant compression at the heel per sq. ft. of buttress = $(5.14 - 3.21) \frac{50}{7} = 13.8$ tons.

The difference between the unit compression in the toe and in the heel is seen to be not very great at the base and is decreasing towards higher elevation until the two stresses become equal, at which elevation the load is uniformly distributed between toe and heel. From here on towards the top of the dam the compression at the heel becomes larger than at the toe.

By varying the slope of the up-stream face, the elevation where the load is uniformly distributed can be shifted up or down as desired. The unit compression along the down-stream edge of the buttress should diminish from the foundation towards the top, as this edge is the least supported portion of the structure, and it adds more to the stability to increase the up-stream slope, thereby throwing the load towards the up-stream edge of the buttresses, than it does to increase the thickness of the buttress, the unit load on these being already low.

Shearing Stresses.

The horizontal component of the water pressure, besides tending to overturn the dam, also has a tendency to shear it off the foundation. Before actual shearing stresses can be fully developed, the friction between the dam body and the foundation must be overcome. This friction is equal to the sum of all the vertical forces x the coefficient of friction = 14,310 x 0.75 = 10,750 tons.

As the horizontal water pressure is 12,207 tons, the amount of pressure tending to shear the structure off the foundation is 12,207 — 10,750 = 1457 tons per 50 ft., giving 1.1 tons per sq. ft., or 15.3 lbs. per sq. in. a negligible amount, showing that practically this structure is only called upon to withstand compression and, therefore, steel reinforcing is unnecessary.

Comparison of Material in the Different Structures.

A 50-ft. section of multiple arch dam contains 3000 yards. A 50-ft. section of straight gravity dam contains 9680 yards. Proportion

$$\text{Proportion } \frac{\text{Multiple arch dam}}{\text{Gravity dam}} = \frac{3000}{9680} \times 100$$

= 31 per cent. of gravity dam.

The amount of material required for a straight gravity dam is seen to be 3.22 times that of a multiple arch dam. Even assuming the unit cost of material for a multiple arch dam to be twice that of a straight gravity dam, it is still possible to construct the multiple arch dam 1.61 times cheaper.

The dam shown in Fig. 1 requires 29 per cent less material than a straight gravity dam across the same canyon. A multiple arch dam would be 25 per cent cheaper to construct, even with unit prices taken twice as high as for the cyclopean concrete used for the single arch. The factor of safety of the single arch section shown in Fig. 1 would, however, undoubtedly be greater than for both a gravity section and a multiple arch section. The unit loads are less and it also has some safety against overturning acting as a gravity dam.

The dam shown in Fig. 2 contains 22.5 per cent less material than a straight gravity dam across the same canyon. The factor of safety of this section would probably also be somewhat higher than both a gravity section and the multiple arch section; the latter, however, would be 31 per cent cheaper to construct, using the same proportion between costs as before.

In the same way the dam shown in Fig. 3 will cost 41 per cent more to construct than a multiple arch dam and the dam also shown on Fig. 4 will cost the same as a straight gravity dam, or 61 per cent more than a multiple arch dam.

From the above it seems evident that the multiple arch dam always has the advantage of requiring less material than any other masonry dam, and, therefore, this type of structure will undoubtedly come into extensive use in the future, at least for moderate heights. For great heights the buttresses must be stiffened or the unit load kept very low to prevent buckling, and this of course adds to the amount of material absolutely necessary.

Examination Surveyor, Philippine Service. The United States Civil Service Commission announces an examination on June 15, 1910, to fill at least fifty vacancies in the position of surveyor, at $1,400 per annum each, in the Philippine service. Field expenses are allowed appointees when absent on duty from their permanent station. Eligibility for the position will be determined upon the evidence furnished in application concerning their education, training, and experience. Applicants qualified as follows will be acceptable as surveyors: (a) Senior year students in civil engineering who are attending recognized technical schools or colleges, and whose records are satisfactory; (b) persons who have had not less than three years' good experience in general land and topographic surveying and in addition thereto a good general education.

DISCHARGE FROM TANGENTIAL IMPULSE WATER WHEELS.

BY S. L. BERRY.

The determination of the discharge capacity of tangential impulse water wheels is intimately connected with the question of the maximum stream which should be applied to a wheel of certain dimensions. In the case of many of the larger units the speed of the wheel is determined by the requirements of the machine to which it is directly connected, and, as the head is also usually fixed in any particular case, the diameter of the wheel is predetermined by conditions over which the manufacturer has little or no control. It then becomes his duty to provide the power called for whether the conditions are as favorable as he would like or not.

There are too many conditions attending the passage of the buckets through the stream which have not yet been worked out to make it possible to provide exact formulae, and the following are given as approximations to assist in design.

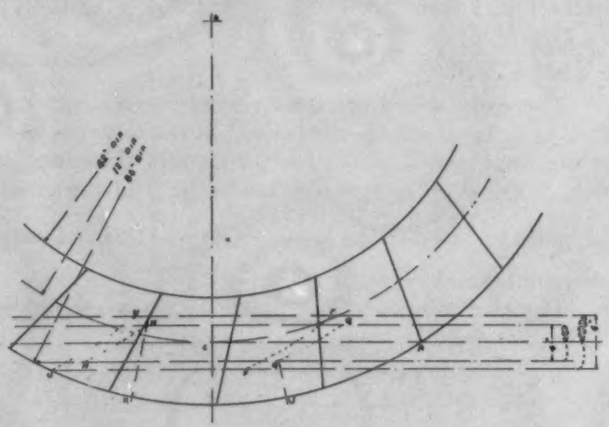


Fig. 1.

Fig. 1 is a diagram of a wheel of the following dimensions:

Pitch diameter	72 in.
Outside diameter	86 in.
Diameter at inner end of buckets	62 in.
Diameter of small jet	4 in.
Diameter of large jet	6 in.
Number of buckets	22 in.
Velocity of pitch line relative to spouting velocity	0.46

An article published in the "Journal of Electricity, Power and Gas," December 25, 1909, explained a method of determining stream paths and points of discharge of the water. Applying that method to Fig. 1, the line GG locates the commencement of discharge for the 4-in. stream from a bucket of proper width, and HH the final; while FF and UU show similar points for the 6-in. stream from its wider bucket.

It will be seen that while the wheel travels from J to K the bucket is discharging the full 4-in. stream, and similar lines drawn through the lower F and upper U will show a shorter arc, located further along in the direction of motion, for the full 6-in. stream discharge.

The length (S) of the slug of water taken care of by each bucket depends upon the pitch (B) of the buckets measured on the pitch circle, and the pitch line

velocity (ϕ) relative to the spouting velocity, and is given by the formula:

$$S = \frac{B}{\phi}$$

This will be the same in all parts of the stream, although the ends of the slugs will not be square.

As the operation of receiving and discharging is continuous, with no piling up of the water in the buckets, the time of discharge will be equal to the time of receipt, and the question becomes one of velocities and areas. The area of the jet and its velocity are given and it remains to determine those quantities in connection with the discharge.

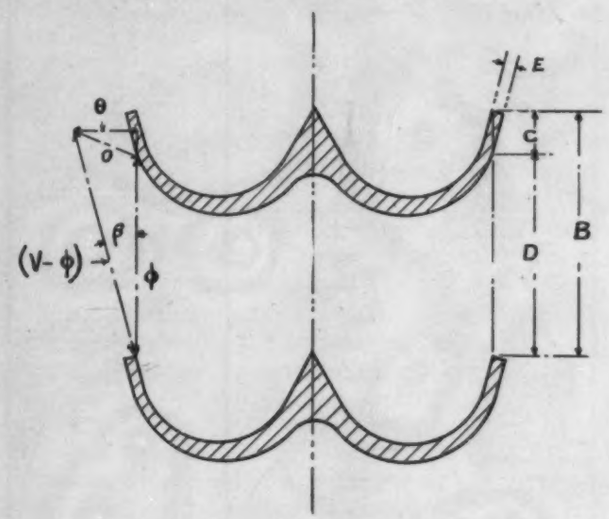


Fig. 2.

Fig. 2 is a section through two buckets on the pitch line, and shows the diagram used to determine discharge velocities. Let

A = Area of jet in square inches.
B = Pitch line spacing of buckets.
C = Space occupied by bucket metal.
D = Space between buckets available for discharge.
E = Thickness of buckets at discharge.
L = Radial length of discharge.
V = Spouting velocity of water.
v = Axial component of discharge velocity.
β = Angle of discharge.
ϕ = Ratio of pitch line velocity to spouting velocity.
o = Ratio of discharge velocity to spouting velocity.
θ = Ratio of axial component of discharge to spouting velocity.

Then

$$C = \frac{E}{\sin.\ \beta}$$

$$D = B - C$$

$$\theta = (V - \phi)\ \sin.\ \beta.$$

The product of the area of the jet by its velocity equals the product of the area of discharge by the axial component of its velocity. As there are two discharges the formula is

$$AV = 2\,v\,DL$$

and

$$L = \frac{A\,V}{2\,v\,D}, \text{ substituting the ratios,}$$

$$L = \frac{A}{2\,\theta\,D}$$

In the example shown,
B = 10.28 in.
E = 0.5 "
ϕ = 0.46
β = 15°.

Then
D = 8.35
θ = 0.14.

Applying the formula to various streams the following values of L result:

Dia. of stream	4"	4½"	5"	5½"	6"	6½"
β = 15°, L =	5.37	6.80	8.40	10.15	12.10	14.17

With the discharge angle β = 10°, the results are very largely increased:

Dia. of stream	4"	4½"	5"	5½"	6"	6½"
β = 10°, L =	9.06	11.5	14.18	17.11	20.4	23.9

It will be seen from the formulae and table that with the relative velocity of the wheel, pitch of buckets, thickness of edge and angle of discharge fixed, the radial length of bucket edge required for discharge varies as the area of the jet or as the square of the diameter, that a wider angle of discharge permits a less length of edge, and that a greater relative bucket velocity requires a greater.

The table shows that with a discharge angle of 15 degrees the discharge of a 6-in. stream occupies about 12 in. (the distance between the inner and outer bucket circles) during the time of full discharge, provided, however, that the design is such that the space (D) between the buckets is completely full. This is an extremely difficult condition to control, and there is considerable danger of overcrowding in this direction. The fact that the discharge edges are curved at their inner and outer ends would add to their actual lengths.

With a discharge angle of 10 degrees, a value of L = 12 in. is reached with a stream of 4.6 in. diameter.

Examination Wireless Telegraph Operator. The United States Civil Service Commission announces an examination on June 1, 1910, to fill a vacancy in the position of electrician and wireless telegraph operator (male), $75 a month, Light-House Service, for duty under the Assistant Inspector of the Twelfth Light-House District, Territory of Hawaii.

FEDERAL CONTROL OF WATER POWER.[1]

BY RUSSELL L. DUNN.

Stripped clear of the acrimonious, motive-impugning discussion, which, expending itself in personalities, has suppressed and concealed the real difference at issue between President Taft, Secretary Ballinger and their supporters, on one side, and a very large number of people led and misled by the late chief officer of the Forestry Department, Mr. Pinchot, on the other side, is that the former maintain that a "permittee" (tenant) on the public land is entitled by law to have the covenants or conditions of his "permit" (tenancy) predetermined precisely and fixed in an Act of Congress, while the latter maintain that the administrative officers should not be interfered with by Congress, because they already put the same covenants and conditions up to "permittees" (tenants) without the aid of Congress in the matter.

It is a difference paralleled by the difference between a court, which has found the accused guilty as charged, but wants to give him benefit of clergy before the Sheriff hangs him, and a howling mob without the court, which, too, having found the accused guilty as charged, would have the Sheriff do the hanging forthwith without any benefit of Congress.

As for the "accused found guilty as charged," who is not apparently consulted over the mode of precedence to his near end by either court or mob, who or what is he?

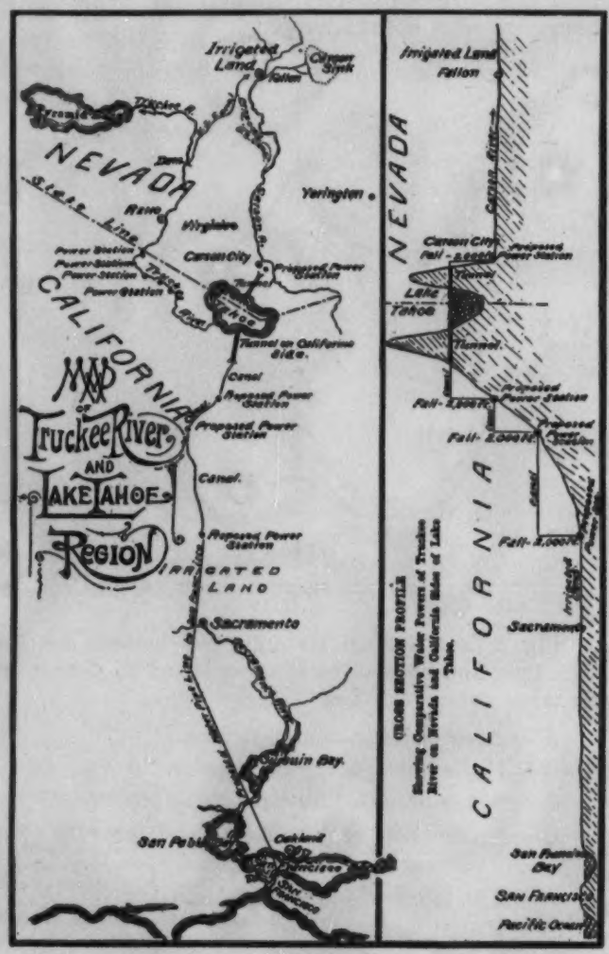
Not the appropriator of water for public purposes or uses, not the great soulless public service corporations, not the portentious predatory "water power trust"—not these undesirable citizens, or any of them, that court and mob alike have been fooled into thinking in their Sheriff's custody primed for the hanging. They are clear out of it, because the right to appropriate and use the flow of the water of the streams is sovereign property of the State, and the State procures for its sovereign property, by virtue of its eminent domain, the easements for rights of way on the public land for emplacement of waterworks.

But the appropriator of water for private purposes and uses is "the accused found guilty as charged"—the gold miner, the lumberman, the cattleman, the farmer—not the "big fellow" but the "little fellow"—the "ultimate consumer." This is he who President Taft and Secretary Ballinger and Mr. Pinchot and Congress and the people will catch with the great chain net of public opinion and the law which they have been dragging at cross purposes for the honor of landing the catch—this is he, "the ultimate consumer." Was there not a reward offered for the discovery of the "ultimate consumer"? There should be a reward for saving him from being caught now that he is discovered.

An Exhibit of Federal Control of Water Appropriation

It has been recently suggested by a United States Senator in a published interview, that although California undoubtedly owned the right to use the water of the streams, it was necessary in the best interest of California for the Federal Government to control the use, as it would require a great many years of Federal education before California would know how to control its own property properly. Perhaps the Senator knows—but, how does he happen to know? Surely not by the control exhibits already made by Secretaries of the Interior and chief officers of departments.

The control undertaken by them over the use of the water of Lake Tahoe and the Truckee River, an interstate lake and river, as both are part in California and part in Nevada, is an exhibit which has been discussed in the newspapers and magazines without informing anyone what it really was. The map here-



with, and the sketch cross section profile with it, are intended to illustrate the explanation of this exhibit of Federal control of the use of water.

The Truckee River naturally dicharges Lake Tahoe in California and after 60 miles of flow in California enters Nevada, discharging itself a hundred miles inside of Nevada into Pyramid Lake. The United States has no riparian proprietorship whatever along the Truckee River in California, there being no public land touching the river, and has only a minor fraction of the riparian frontage from public land in Nevada. The Federal Government officials thus appear as basing their right of invasion of the two States on a claim of direct control of the water flow by virtue of ownership of it, and not through ownership of land, by the United States.

[1]Extract from "The Control of Use of Stream Water in the United States," published in pamphlet form by the author.

Between Lake Tahoe and the California boundary the Truckee River water falls very uniformly through its course a total of 2,000 feet. Part of this fall, altogether about 700 feet, is used by means of five electric power generating stations, the power produced being consumed in public service, a little locally, and the larger part in Nevada at Reno, Virginia City, Carson City and Yerington. None of the river water is consumed in California, all of it flowing by the river into Nevada after passing the water wheels.

The United States Reclamation Department has diverted part of the Truckee River water in Nevada and conducting it by a canal has distributed it for irrigation over lands in the sink region (ancient dried up lake bed) of Carson River, for which the Carson River did not by itself provide a sufficient irrigation water supply.

About eighteen months ago the United States Reclamation Department and the public service corporation operating the power stations seem to have simultaneously discovered, the former that it wanted more water from the Truckee River for its irrigation service, and the latter that it wanted more power from the fall of the water of Truckee River together with a cheaper and more certain opportunity to get it than by building more power stations along the Truckee River.

Thereupon, a contract was entered into between the United States by the Secretary of the Interior and several chiefs of departments (assuming authority under the Act of Feb. 15, 1901), and the public service corporation. The contract is like a diplomatic treaty between high contracting parties in that one can read it without finding out from it what any party expects to get—really get—under its covenants.

Disregarding the formal words and loosely expressed covenants, and going instead to the heart of the matter, this is what the public service corporation expects to get under it:

(1) The right to tunnel through the mountain rim on the Nevada side of Lake Tahoe, by means of which it will be able to use all of the water which would flow from the lake in a single fall of 2,000 feet, thereby trebling the quantity of its electric horsepower output and having all the economy of operation of a single power station as against seven or eight along Truckee River.

(2) The power of the Federal Government to close the natural outlet of Lake Tahoe into the Truckee River so that the water will have to be discharged through the power company tunnel.

And this is what the United States Reclamation Department would get:

(1) The water of Lake Tahoe discharged from the power station into Carson River instead of into Truckee River—the same water but not any more water—which the United States Reclamation Department would then conduct to the same land which it is now irrigating by means of a new canal from the Carson River instead of the already constructed canal from Truckee River.

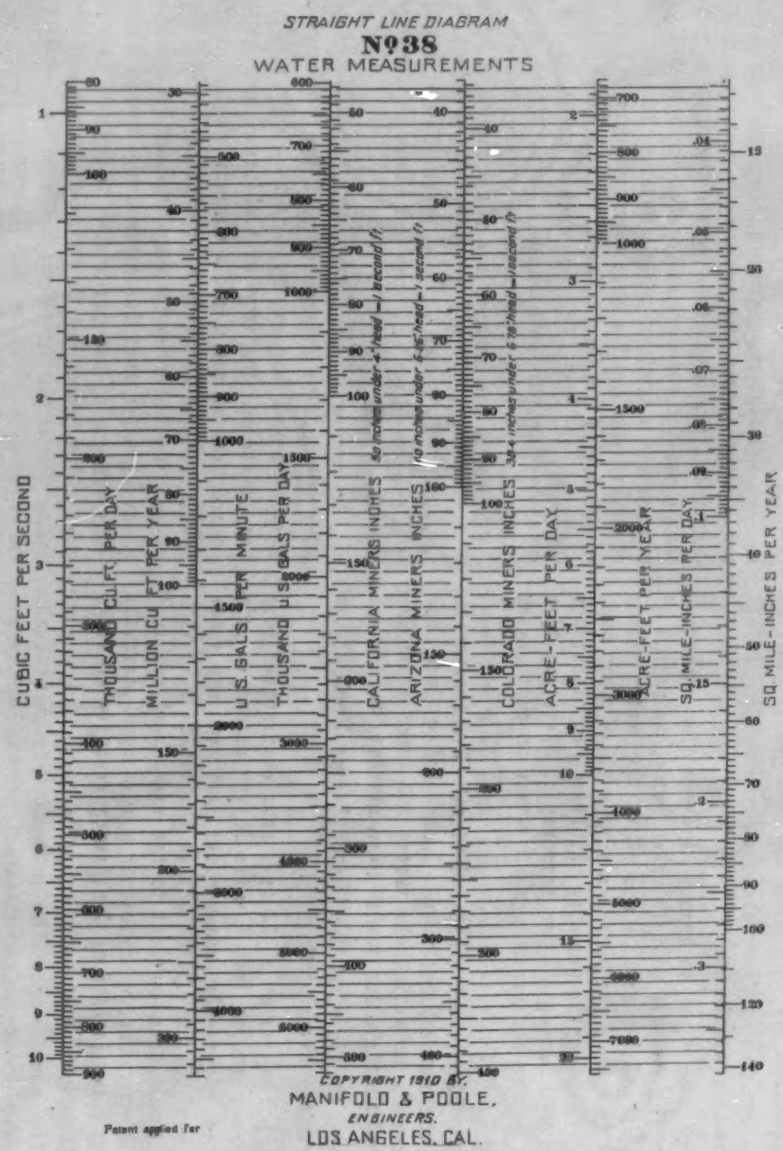
The preceding is the practical business of the contract. Consider the contract now as an instrument of Conservation by Federal control of the use of the water flow of Truckee River, keeping in mind that the chief officers of Federal departments disregarding the State boundaries in providing for the diversion of the flow of Truckee River through California into Nevada, must assume that they could just as well have provided for the diversion the other way, from Nevada into California, a plan of diversion, by the way, which was proposed by engineers forty years ago to supply San Francisco with water.

Referring to the map and cross-section profile sketch, it will be noted that diverting Truckee River water from Lake Tahoe by means of a tunnel through the mountain rim on the California side, the same water could be used through three falls, each of 2,000 feet, to produce electric power, and the water would then be in a region in California in which the land has a productiveness under irrigation double that of the land in the Carson sink in Nevada—or the water could be used for the domestic supply of San Francisco in place of irrigation.

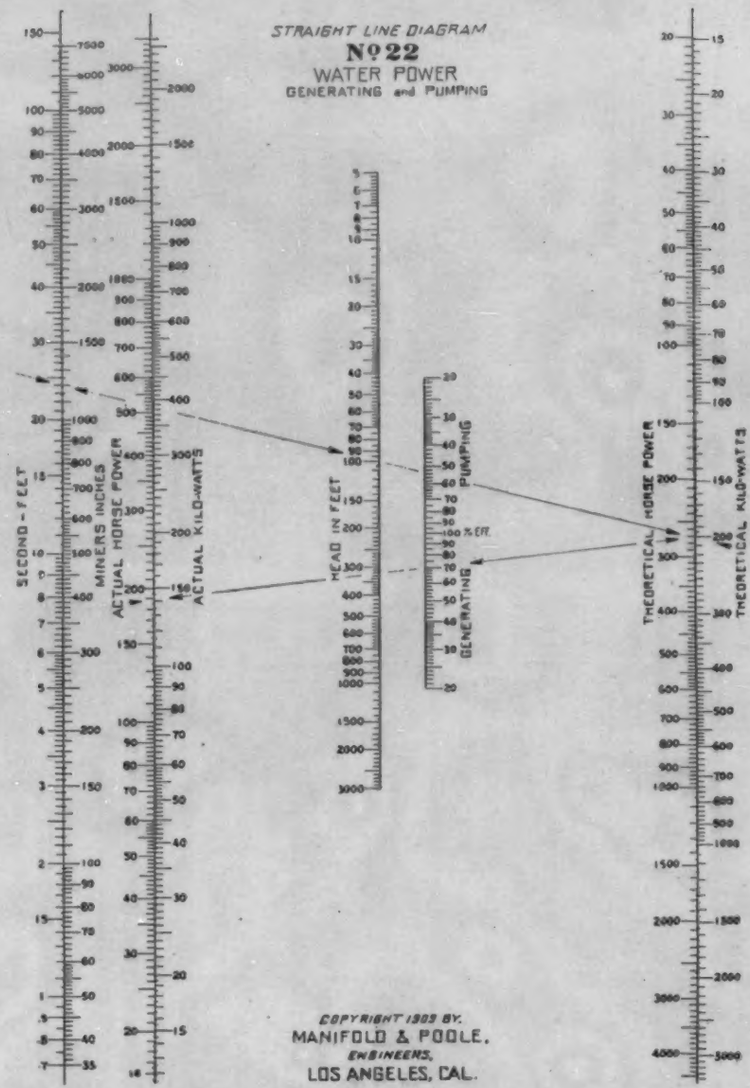
If "conservation" of the use of water means anything but a meaningless political "war-cry," it means getting all of the use out of the flow of the water that it can be made to give. Obviously in this particular exhibit the Federal control has only provided for getting one-third of the possible electric power and not much more than half the possible irrigation service. Apprentice work may be the reason for such a result but the "baby act" plea will not excuse it. Would the State control of the use of the water flow of Truckee River show such a poor "conservation" result? Hardly—but California has never assumed that it could lawfully divert the water of Truckee River from Nevada, nor has Nevada ever assumed that it could lawfully divert the water of Truckee from its natural flow through California directly into Nevada by a tunnel in the Nevada jurisdiction. The Supreme Court of the United States has invariably ruled against such doctrine. It is also quite beyond the legal power of a public service corporation, or the legal power of any citizen, by a contract with anybody, to take outside of its jurisdiction, the sovereign property of California in the use of the flow of the Truckee River within its own jurisdiction. The contract after all is only an exhibit of a carelessness of official action by chief officers of Federal departments which amounts to indifference to the current law of the rights of property. It has not affected the property rights which it was intended to dispose of any more than if the paper it is engrossed on had been left blank as it came from the paper mill.

In review of the foregoing, it would seem, that with the right to appropriate and use the water in the streams which flow on, by, or adjacent to public land, the sovereign property of California, and with the jurisdiction of the State's eminent domain over the public lands with which to procure easements of rights of way for water works emplacement for public purposes and uses, that the imposition, through erroneous assumptions, of the burdens of a Federal jurisdiction over either water use or rights of way easements for water works on the public lands in California should be impossible. But, as Brer Jasper preaches, "De sun do move." Anything is possible in California.

STRAIGHT LINE DIAGRAMS FOR CONVERSION OF WATER POWER UNITS AND DETERMINATION OF WATER POWER.



To find equivalent values, follow horizontal lines.



To find power generated connect quantity (sec. ft. or miner's inches) with head in feet by means of a straight edge, rotating to assumed efficiency to find actual power. To find power required for pumping reverse above operation.

THE WATTHOUR METER.

BY WM. M. SHEPARD AND ALLEN G. JONES.

CHAPTER VII.

(Continued.)

Phantom Loads.

A method of testing watthour meters under full load conditions with a small consumption of power is to connect the potential circuit of the meter in the usual way and connect the current coils in series with the secondary of a small transformer especially designed for this purpose, the primary of the transformer being connected in parallel with the line as shown in Figure 92, therefore having the same impressed upon it as upon the potential coil of the meter. The resistance (R) is connected in series with the secondary windings, so that portions of it can be short circuited by means of suitable plugs or switches in order that

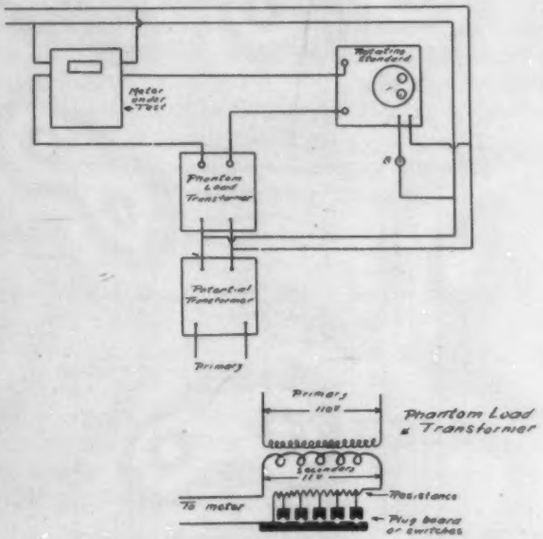


Fig. 92.

the desired current may be obtained. If the transformer is properly designed and the connections properly made, the secondary current flowing through the current coils of the meter will be approximately in phase with the impressed e.m.f. Full load current or desirable portions of full load current can be obtained for the meter under test, while the primary circuit takes only a very small amount of current from the line. This method of testing is especially convenient in testing meters on high potential circuits, as the potential transformers ordinarily used can also be made to supply the current for testing purposes through the agency of this "phantom load transformer." Such a transformer is usually designed to take about one-half ampere at 110 volts, while supplying 5 amperes to the meter under test.

The "phantom load transformer" is small and compact and can be easily carried from place to place; in connection with the portable rotating standard it furnishes a very complete set for testing the average size service meter. This transformer can be very advantageously used for testing meters on 50 per cent power factor where three-phase current is available, which is always the case where this adjustment is most important, namely on three-phase power circuits.

Let Figure 93 represent the vector diagram of the voltages in a three-phase system; then if the voltage AC is impressed upon the potential winding of the meter, and the primary of the phantom load transformer is connected across BA or BC, the current flowing in the secondary of the transformer, and therefore through the meter windings, will be 60 degrees out of phase with the voltage AC, or in other words, we will have a power factor of 50 per cent. One of the connections referred to will give a 50 per cent leading power factor and the other will give a 50 per cent lagging power factor, but it is better to make any necessary adjustments on lagging power factor, as the meter usually operates under this condition.

To distinguish between the connection for leading power and lagging power factor, most of the resistance in the secondary circuit of the phantom load transformer is short circuited and a reactance cut into the circuit. This reactance causes the current in the secondary to lag behind the secondary e.m.f., and when the primary of the transformer is connected across the proper lines to give a lagging power factor in the meter under test, the current will lag more than

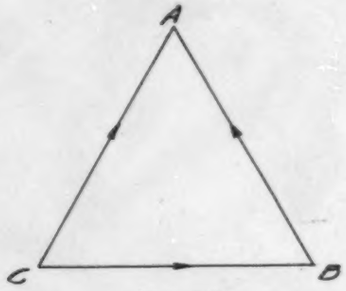


Fig. 93.

60 degrees, and the power factor will therefore be less than 50 per cent, while if connected to the proper lines for leading power factor the current will lag less than 60 degrees and the power factor will therefore be more than 50 per cent, thereby causing the meter to run slower when the transformer is connected across the proper lines for lagging power factor; as soon as this is determined the reactance is switched out, the power factor then being approximately 50 per cent lagging, after which the test may be continued.

The Knopp Method of Meter Testing.

A method in use by the Pacific Gas & Electric Co., of San Francisco, Cal., for testing watthour meters, and known as the "Knopp method" is as follows:

The tester is provided with a portable resistance box upon which is mounted an indicating ammeter, illustration of which is shown in Fig. 94 (a); he is also supplied with a stop watch which has a special dial that indicates millihours rather than seconds; the large hand (corresponding to the second hand of the ordinary stop watch) of this watch makes one revolution in 36 seconds, the dial being divided into 100 equal parts, each division representing 1-10 millihour. The resistance box has several coils, different combinations of which are used for different loads, each coil being adjusted to consume a definite amount of power at a predetermined potential. The box also has a variable resistance in series with the loading resistance, which

can be varied by means of a sliding contact provided for that purpose. By the use of this variable resistance the voltage drop across it may be made equal to the difference between the line voltage and the predetermined (100 volts) voltage, or in other words, so that this voltage is impressed upon the load resistance regardless of the value of the line voltage, which condition when reached will be indicated by the ammeter; that is, for any coil the ammeter will indicate a certain definite current. The potential tap for the watthour meter is connected inside of the resistance box so that the voltage impressed upon the meter will be the same as that impressed upon the load coils.

The load coils of the portable resistance box are adjusted to consume such an amount of power that the meter to be tested will, if correct, make one, ten or twenty revolutions in 36 seconds, or during one complete revolution of the hand of the special millihour watch. All that the meter tester has to do, therefore,

Fig. 94a.

is to connect in the box, obtain the proper current (by means of the various resistances), as indicated by the ammeter, and then note the time with the special stop watch of one, ten or twenty revolutions of the meter disc, depending upon which load the meter is being tested. From the reading of the stop watch the accuracy of the meter can be obtained directly without the use of a formula. If the watch has made exactly one revolution (for the load chosen), the meter is correct, while if the hand of the watch lacks two divisions the meter is approximately 2 per cent fast, or if the hand has made a complete revolution and two divisions past, the meter is approximately 2 per cent slow. This method of testing service watthour meters is convenient, since the outfit is light and compact, and it is also very quick.

Figure 94 (b) shows the diagram of connections of the "Knopp set," the name being derived from the patentee, Mr. Otto A. Knopp. For testing 110-volt meters, the plugs o, a, b and c are used, and for testing 220-volt meters the plugs o', a', b', c' and d are used. An example of the method of using this set is as follows: Suppose that it is desired to test a 5-ampere, 110-volt induction watthour meter having a calibrating constant of .3. The box is connected into circuit and a resistance is plugged in to give 600 watts; the variable resistance is adjusted until the ammeter indicates 0.600 ampere (1-10 of the current passing in shunt through the ammeter). The time for 20 revolutions of the disc is taken with the millihour watch; the time taken for the 20 revolutions should be the same as taken for one revolution of the hand of the watch. The percentage error will be indicated by the watch, as has already been explained. When the meter has been adjusted for full load (600 watts approximately), another resistance which takes 30 watts is plugged into circuit and the 600-watt load cut out; the variable resistance is adjusted until the ammeter indicates 0.30 ampere; if the meter is correct the disc will make one revolution while the hand of the millihour watch makes one revolution.

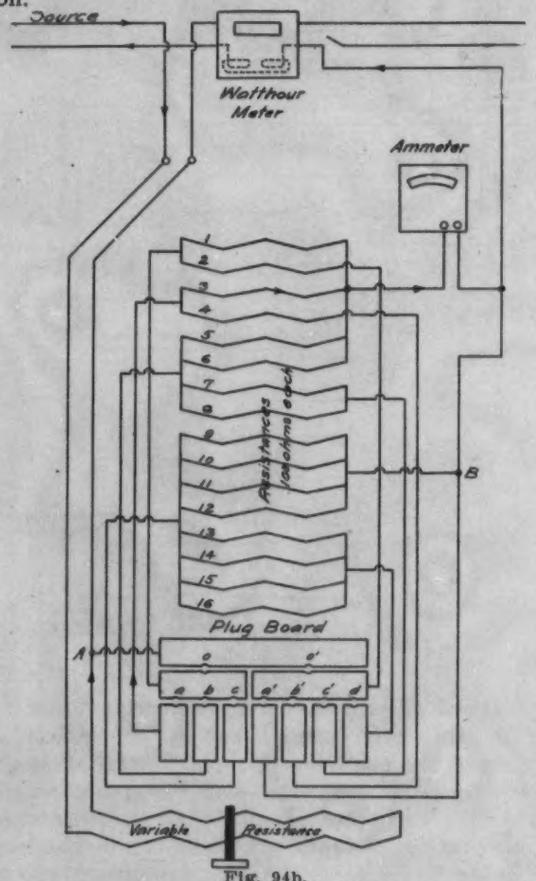


Fig. 94b.

The voltage of the circuit can be read with this outfit by switching in the 1-ampere resistance coil and cutting the variable resistance entirely out. The 1-ampere coil has a resistance of 100 ohms, and when the line voltage is impressed upon this resistance which is in series with the ammeter (which is 1.5 amperes capacity), the voltage of the circuit can be read directly from the ammeter. Thus if the line voltage is 100, the ammeter will indicate 1.0 ampere or if the line voltage is 110 the ammeter will indicate 1.10 amperes, etc.

By referring to the diagram (Figure 94), it will be seen that for the higher loads the ammeter is connected in shunt with the resistances, thereby taking only a part of the total current. By employing this method of connection, the ammeter is only used over the most accurate part of the scale while testing watt hour meters of different sizes and at different loads.

The Knopp millihour watch can also be used to advantage when testing with ordinary indicating instruments, since it has the advantage of simplifying the testing formula to some extent; the formula

$$P = \frac{R \times K \times 3600}{t}, \text{ becomes } P = \frac{R \times K \times 1000}{t'},$$

where t' is the time is millihours as read with the special stop watch.

When calibrating meters in the testing room with this special watch the load can be adjusted to be such a multiple of the disc constant that the disc will make one, ten or twenty revolutions for one revolution of the hand of the stop watch when the meter is correct. If the meter is not correct, the percentage inaccuracy will be indicated by the watch. Thus, if the meter is fast the watch hand will not quite make a complete revolution, while if the meter is slow the hand will make more than a complete revolution.

The number of divisions which the hand lacks of a complete revolution is the percentage by which the meter is fast. The number of divisions by which the hand has passed a complete revolution is the percentage by which the meter is slow.

In using this method of testing, the proper load is obtained from the following formula:

$$P = \frac{R \times K \times 10000}{t'},$$

$Pt' = R \times K \times 10000$; for one revolution of the stop-watch hand, $t' = 100$, therefore

$$100\,P = R \times K \times 10{,}000,$$
$$\text{or } P = R \times K \times 100.$$

For a 5-ampere meter having a constant of K=.3, and using one revolution of the disc for light load test gives P=30 watts. For full load test taking R=20, we will get P=600 watts.

Portable Testing Set for Direct Current Watt Hour Meters.

For outside testing of direct current meters the set as shown diagramatically in Figure 95, will be found to be convenient; it is compact and light, therefore easy for the tester to carry from place to place. The current is furnished for the smaller sizes of meters (5, 10 and 15 amperes), from an ordinary dry cell, and for larger meters from the improved type of Edison storage battery, the current being regulated by the plug resistances. The potential is taken from the line through the variable resistance which is regulated by a sliding contact block. Potential and current are supplied alike to the watthour meter under test and to the combination volt-ampere indicating meter shown at the top of the diagram. For convenience of testing, the volt-ampere meter has several potential and current ranges. The volt-ampere meter also indicates watts, the indication being shown on a scale directly beneath the intersection of the volt needle and the ampere needle. After selecting the proper current as indicated by the combination meter, the wattage is held constant by means of the variable potential resistance.

Adjustments.

In any type of meter if the actual value of P (in above formula) is greater than that expressed by the calibrating equation the meter under test is slow, and if this value is less the meter is fast. If we represent the power as registered by the watthour meter by P', and the true power as indicated by the standard by P, the error in percentage may be expressed by the equation, $\text{error} = \frac{P - P'}{P} \times 100$. In calibrating watthour meters it will be found to be more convenient to use the term "percentage of accuracy" or "correction factor" rather than the term "percentage error," since the former method involves less work in making the computations. For example:

$$\text{Percentage of accuracy} = \frac{P'}{P} \times 100,$$

$$\text{Correction factor} = \frac{P}{P'}$$

If the percentage of accuracy is less than 100 the meter is slow; if it is greater the meter is fast. If the correction factor is less than 1 the meter is fast, and if it is more than 1 the meter is slow.

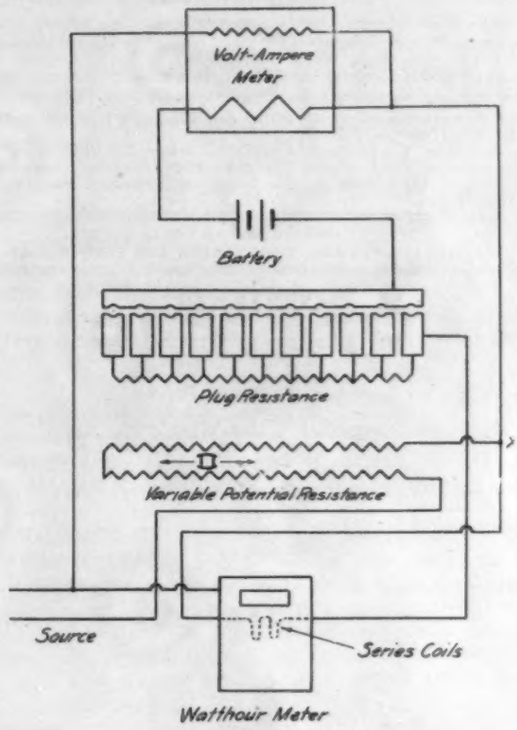


Fig. 95.

If the watthour meter under test is found to be inaccurate at or near full load, the retarding magnets should be adjusted until the meter registers correctly. If it is slow, the magnets should be moved in toward the center of the disc, which operation will increase the speed, while if the meter is fast the retarding magnets should be moved out toward the periphery of the disc.

If the meter under test is found to be slow on light loads, undue friction should be looked for and eliminated, and the light load adjustment (as previously explained for various kinds of meters) reset. If the meter is fast on very light loads, or if it "creeps," the light load adjusting device is very probably exerting too much torque, and its effect should be decreased until the meter is within 2 per cent accuracy on a 5 per cent load.

(To be continued.)

JOURNAL OF ELECTRICITY
POWER AND GAS

PUBLISHED WEEKLY BY THE
Technical Publishing Company

E. B. STRONG, President
A. H. HALLORAN, Vice President and Managing Editor
C. L. CORY, Secretary.

DIRECTORS
R. J. DAVIS A. M. HUNT A. H. HALLORAN C. L. CORY E. B. STRONG

604 MISSION STREET, SAN FRANCISCO

EASTERN OFFICE, 150 NASSAU STREET, NEW YORK
C. N. MANFRED, Eastern Manager

TERMS OF SUBSCRIPTION

United States, Cuba and Mexico	per year,	$2.50
Dominion of Canada	"	3.50
Other Foreign Countries within the Postal Union	"	5.00
Single Copies, Current Month	each	.10
Single Copies, prior to Current Month	"	.25

NOTICE TO ADVERTISERS

Changes of advertising copy should reach this office *ten days in advance of date of issue.* New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July 1895.
Entry changed to "The Journal of Electricity," September, 1895.
Entry changed to "The Journal of Electricity, Power and Gas," August 15, 1899.
Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas." Weekly.

FOUNDED 1887 AS THE
PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

CONTENTS

Arched Dams 469
By L. R. Jorgensen.

Examination for Surveyor, Philippine Service 374

Discharge from Tangential Water Wheels 374
By S. L. Berry.

Examination Wireless Telegraph Operator 375

Federal Control of Water Power 376
By Russell L. Dunn.

Straight Line Engineering Diagrams 378
By Manifold and Poole.
Water Measurement.
Water Power.

The Watthour Meter 379
By Shepard and Jones.
Phantom Loads.
Testing With Instruments.

Editorial 382
Discharge of Impulse Water Wheels.
Multiple Arch Dams.

Personals 383

San Francisco Sons of Jove 383

N. A. S. E. Convention 383

Pacific Coast Electrical Exposition 383

Industrial 384
G. & W. Potheads.

Portland Section, A. I. E. E. 385

Pipe Calculator 386
By Rudolph W. Van Norden.

New Catalogues 388

Trade Notes 388

News Notes 389

Discharge of Impulse Water Wheels

The three limiting conditions which govern the power that may be generated by a water wheel are the head under which it is operated, the speed at which it may be run, and the quantity of water which it will discharge. As the head is fixed by the physiographic conditions, a matter of geologic relief, and as the speed is usually limited by the safe velocity of the generator, a matter of the strength of materials, the last condition is the only one which the wheel designer may increase. Several excellent methods of calculating turbine discharge have been devised, especially by the Germans, and are closely confirmed by experiment, but for the impulse type water wheel, few designers have investigated the influence of the angle of discharge and of the radial length of the bucket edge upon the wheel capacity. This lack has been admirably supplied by Mr. S. L. Berry elsewhere in these columns, and his conclusions are worthy of careful study.

Multiple Arch Dams

A notable contribution to the series of discussions on multiple arch dams that has recently been published in these columns is that of Mr. L. R. Jorgensen on another page of this issue. The first American dam of this type, embodying piers joined by vertical arches, was that built by Mr. John S. Eastwood at Hume Lake in Fresno County, California. Mr. Eastwood was the first American engineer who had the courage of his convictions to actually build a dam which so radically departed from recognized standards. Others had proposed such a possibility, but he demonstrated its practicability.

Improvement in engineering design is a matter of evolution. The ancient Roman mythology could conceive of a "Minerva springing full-panoplied from the brow of Jove," but modern experience has shown that it is only by gradual development that permanent structures are executed. The curved dam meets certain requirements for which the straight gravity type, its predecessor, is not adapted, particularly in economy of material. Likewise the multiple arch is an improvement on the single arch span which it succeeds, effecting even greater saving in material.

Mr. Jorgensen has prepared a number of designs, and draws comparison between several single arch dams, all one hundred and twenty-five feet high, but designed for spans varying from two hundred to six hundred feet, the latter being the economical limit for this type. He clearly demonstrates that they have a higher factor of saftey and contain less material than the usual straight model. He then shows that the multiple arch makes a yet greater saving in material and is subject to compressive stresses alone. It consequently needs no steel reinforcement. These conclusions corroborate Mr. Eastwood's original contentions and suggest that this type of structure should be more extensively used for moderate heights.

PERSONALS.

A. M. Hunt has returned from a business trip to Portland.

G. W. Price has returned to San Francisco from Los Angeles.

F. H. Poss, of the Benjamin Manufacturing Company, is at Portland.

H. B. Vanzwoll, secretary of the Sunbeam Lamp Company, is at San Francisco.

H. E. Adams, general manager of the Stockton Gas & Electric Corporation, was a San Francisco visitor.

J. A. Herr, representing the Pacific Coast agency of the Sprague Electric Company, is in Southern California.

F. A. Cressey Jr., superintendent of the electric lighting system at Modesto, Cal., was at San Francisco last week.

Frank R. Schaich, traveling representative of the Electrical Review and Western Electrician of Chicago, is at Portland.

R. M. Durbin, formerly with the G. W. Prince Pump Company, is now chief engineer for the Ridge Land Company of Los Angeles.

C. R. Downs, of the Amador Electric Railway & Light Company, of Sutter Creek, Cal., recently spent a few days in San Francisco.

H. Vance Lane, president of the Rocky Mountain Telephone Company, of Salt Lake City, Utah, visited San Francisco last week.

F. C. Nelson, vice-president of the Tri-State Telephone & Telegraph Company of St. Paul, Minn., was a San Francisco visitor last week.

H. H. Noble, president of the Northern California Power Company, has returned from Shasta County, where he inspected some of his electric installations.

Guy W. Talbot, vice-president and general manager of the Oregon Electric Railway, Portland, Ore., has been elected president of the Portland Gas & Coke Company, Portland, Ore.

R. D. Holabird left San Francisco this week to attend the convention of the National Electric Lamp Association. There he will meet W. W. Briggs.

W. S. Barstow, of W. S. Barstow & Co., the New York firm which constructed the Oregon Electric Railway Line extending from Portland to Salem, stopped over two days at San Francisco on his way East, en route from Oregon.

Belvedere Brooks, vice-president and general manager of the Western Union Telegraph Company, who is making a tour of the Pacific Coast for the purpose of gaining information as to the needs of the service in the way of betterments, will spend several days in San Francisco.

E. N. Sanderson, of Sanderson & Porter, New York, spent a few days at San Francisco while making an extensive business tour of the country. He will next visit the Pacific Northwest, his firm having purchased the electric lighting and traction system at Aberdeen, Wash.

SAN FRANCISCO SONS OF JOVE.

At the regular bi-weekly luncheon of the San Francisco Sons of Jove at the Techau Tavern, on May 19th, announcement was made of the new officers appointed by Statesman W. W. Briggs, as follows: A. E. Drendell, Jupiter; W. S. Berry, Neptune; C. E. Wiggins, Mercury; S. P. Russell, Pluto; R. L. Phelps, Vulcun; C. C. Davis, Hercules; W .W. Hanbridge, Mars; A. E. Rowe, Apollo; F. H. Poss, Avrenim. It is planned to hold a record-breaking rejuvenation on August 13th.

N. A. S. E. CONVENTION.

Following is the program for the seventh annual convention of the California State Association of the National Association of Stationary Engineers, to be held at Los Angeles, May 23rd to 28th:

Monday, May 23.

Arrival of delegates and opening exhibit at 2 p. m.

Formal opening of exhibit at 8 p. m.

Introduction of Mayor Alexander by Past National President Fred J. Fischer.

Address of welcome by the Mayor.

Response and opening of exhibit by State President J. N. Pyster.

Tuesday, May 24.

Exhibit hall open from 10 a. m. to 10 p. m.

Opening of State convention in banquet hall of Angelus Hotel at 9 a. m.

Convention in session at 2 p. m.

Visiting exhibit in evening until 10 p. m.

Wednesday, May 25.

Balloon Route excursion to Hollywood, Palisades, Long Wharf, Santa Monica, Ocean Park, Venice and Redondo, where the plant of the Pacific Light & Power Company will be visited, leaving the Los Angeles-Pacific depot on Hill street at 9:30 a. m. Bathing and luncheon at one of the beach resorts. Theater party in the evening for delegates and visitors.

Thursday, May 26.

Convention in session at 9 a. m.

Convention in session at 2 p. m.

Automobile ride for visiting ladies, tendered by ladies' auxiliary, N. A. S. E., at 10 a. m.

Social dance at Goldberg-Bosley Assembly Hall, Sixteenth and Flower streets, at 8:30 p. m.

Friday, May 27.

Convention in session at 9 a. m.

Convention in session at 2 p. m.

Reception for visiting ladies by ladies' auxiliary, N. A. S E., at Odd Fellows' Hall, 220½ South Main street, at 2:30 p. m.

Regular meeting of Los Angeles Association No. 2 and installation of State officers at 8 p. m., after which all members will visit the exhibit.

Saturday, May 28.

Excursion to Long Beach and basket picnic on pleasure pier, leaving Los Angeles from Pacific Electric depot, at Sixth and Main streets, at 10 a. m. Surf and plunge bathing and inspection of United States government $3,000,000 breakwater and harbor at San Pedro in afternoon.

Banquet at Hamburger Cafe at 8 p. m. and closing of exhibit.

Exhibit open every day from 10 a. m. to 10 p. m.

Band concert every afternoon and evening in exhibit hall.

PACIFIC COAST ELECTRICAL EXPOSITION.

The executive committee are pleased to announce to the exhibitors of the Pacific Coast Electrical Exposition that the date of opening of said exposition has been definitely set for August 20, 1910, (to continue for eight days) at the new Coliseum, Baker, Oak and Fell streets, San Francisco, Cal.

W. W. BRIGGS,
JOHN R. COLE,
J. A. VANDEGRIFT,
WM. L. GOODWIN,
ALBERT H. ELLIOT,
Executive Committee.

INDUSTRIAL

THE USE OF POT HEADS FOR CABLE TERMINALS.

The art of installing lead covered cables has been vastly improved within the last five years by the introduction of facilities for properly terminating such cables in the form of pot heads. Formerly the only means available for terminating a cable consisted in a lead sleeve left open at one end, or a brass bell wiped to the lead sheath and filled with compound.

Fig. 1.

Fig. 2.

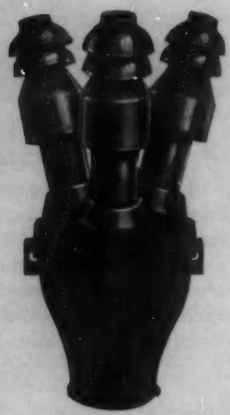


Fig. 3.

These devices were not all adapted to out of door conditions, and did not provide any means of disconnecting the conductors at the cable terminal except through a separate device such as a switch or cutout box.

The necessity for a pot head which was suited to outdoor conditions, and which permitted the circuit to be easily opened at the cable end, led the engineers of the G & W Electric Specialty Company of Chicago to develop the line of detachable porcelain pot heads which they have been placing among cable users for the past six years.

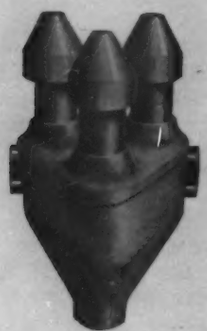


Fig. 4.

Fig. 5.

The use of a porcelain sleeve with an insulator type of cap solved the problem of exposure to the weather. The happy combination of suitable current carrying parts contained within the porcelain produced a device which is detachable; that is, without tools of any kind, an operating man may disconnect the circuit by the simple act of lifting the cap from the tube. When the circuit is to be closed the cap is replaced and the connection is simultaneously made. This form also permits the installation of this device in manholes, as the bell-shaped cap retains sufficient air to keep out the water in case the manhole should fill with water.

This is one of the distinctive features of the G & W line, the value of which should not be overlooked. The cost of cut-out boxes on outside lines and knife switches on inside work as disconnectives is entirely saved by the use of the detachable types. It has been the aim of the company to provide an absolutely complete line of pot heads for light and power work. It therefore offers pot heads for single or multiple-conductor cables up to 10 conductor cables, detachable or non-detachable, combination pot heads and series cutouts, combination pot heads and subway cutouts and any other special forms which engineers may require up to 33,000 volts.

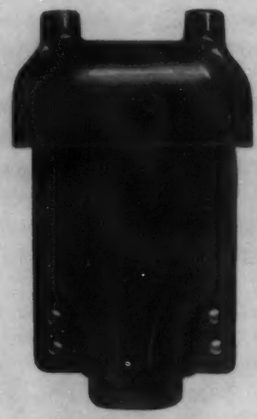


Fig. 6.

The pot heads for single-conductor are known as type "S" (illustrated in Fig. 1), suitable for cables up to 00, and the type "TS" (illustrated in Fig. 2), intended for cables larger than 00. The type "TS" is provided for any cable up to 1,000,000 c.m. The pot heads for multiple-conductor cables are known as form "L" for voltages up to 7500 (shown in Fig. 3), and form "M" for voltages from 7500 to 15,000 (shown in Fig. 4). Both of these types of pot heads are made for two, three or four-conductor cable.

Form "L" and form "M" pot heads are furnished with adapters by which the lower end of the pot head may be fitted to any size standard wrought-iron pipe from 1½ to 3 in. inside diameter if desired. The station type of pot head (shown in Fig. 5) consists of a porcelain lid and band which is supported on a threaded iron collar so designed that it may be attached direct to the sheath of the cable. The combination pot heads are shown in Figs. 6 and 7; Fig. 6 being a combination pot head and series arc cutout. This device is small enough to be installed inside the base of a lamp pole and is no more expensive than the ordinary forms of absolute cutout which

Fig. 7.

do not provide any means of sealing in the ends of the cables from moisture. This device can also be installed in manholes or handholes, as it will operate when submerged. This cutout is also furnished for use simply as a cutout on overhead lines where the pot head feature is not required and is an absolute cutout in that the connections to the loop are entirely removed from the base which carries the circuit connections when the loop is disconnected.

The subway cutout (shown in Fig. 7) is designed to take an enclosed fuse or a disconnecting switch blade as may be desired. The lower part of the cutout is filled with compound after the cables are connected, thus providing an absolute seal against moisture getting into the cables. In addition to this the cover of the iron box is provided with a long overlap which

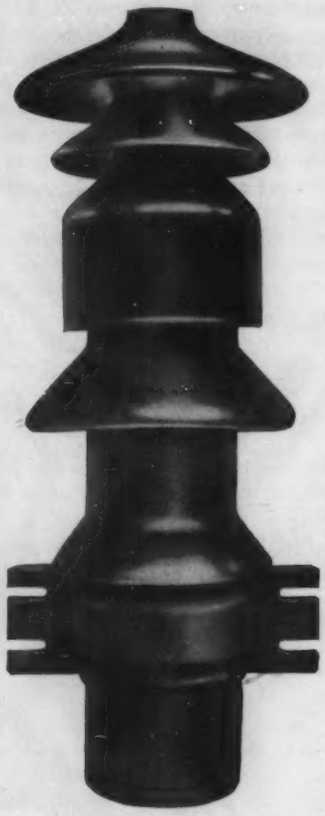


Fig 8.

prevents any water from getting into the box in case it is submerged. A rubber gasket in the cover prevents the circulation of moist air and thus preserves the arc smothering material in the enclosed fuse. These junction boxes are made for two, three or four-conductor cables and for either straight connections or half tap.

The type "S" and type "TS" pot heads are designed for voltages up to 15,000. For voltages from 15,000 to 35,000 the type "HS" is provided. The type "HS" for single-conductor cable is shown in Fig. 8. This also is made up for multiple-conductor cables in a form similar to the type "M."

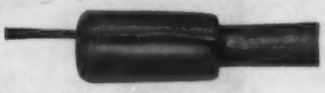


Fig. 9.

In addition to their line of pot heads, this company also places on the market a malleable iron cap shown in Fig. 9, by which ground wires may be connected to ground pipes with a driving fit without making a soldered connection, the malleable iron cap being used as a driving head to protect the end of the pipe while it is being driven.

A CONVENTION EXHIBIT WORTH WHILE.

Following their usual custom, The Kellogg Switchboard & Supply Company provided exceptionally fine and instructive exhibits at the recent Kansas and Missouri conventions held at Topeka and St. Joseph.

The same exhibit apparatus was used at both conventions and an unusually large number of interesting features were shown. Altogether the exhibit contained three switchboards and a thoroughly representative assortment of telephones and smaller apparatus. A 200-line, two-position magneto board, fully equipped with line and cord and transfer circuits, together with calling and disconnect pilot lamps showed the perfection to which magneto equipment has been brought by the Kellogg Company. The cord circuits in this board were all of the improved double supervisory non-interfering type described in Kellogg Bulletin No. 32. It was shown that these cord circuits not only insure the absolute operation of ring-off drops, but that with them it is impossible for any party on any line to ring through the board and falsely disturb the bell of any party on any connected line.

Another feature of great interest was the demonstration of The Kellogg Company's new four- and eight-party Harmonic ringing apparatus for magneto exchanges. This system operates from dry batteries, absolutely without transformers. The only expense for central office equipment being a master key in each operator's position and a four frequency, inexpensive, wall mounting interrupter unit at the central office. The telephones used on this system can be any form of magneto instruments fitted with harmonic ringers. No condensers are required in the telephones; neither is it necessary to have direct current generators or other special features. The switchboard drop can be any resistance from 100 ohms up. The demonstration of this apparatus was most thorough and rigid and necessarily convincing. One of the four telephones had purposely been equipped with a 5-bar A. C. generator to demonstrate the impossibility of tapping any bells when calling central or ringing off. An artificial condition had also been set up for demonstrating the absence of induction on parallel grounded lines when ringing even with the 66-cycle current. The four-frequency interrupter unit was shown to operate absolutely sparkless, under all conditions, thus insuring indefinitely long life to the heavy platinum contacts with which the apparatus is provided.

A fifty-line lamp signal private branch hotel switchboard was shown arranged with simultaneous loud ringing and common talking keys for use in case of fire. This board was also arranged so that all incoming calls can be answered by means of the common answering key without touching any plugs and cords. A desk set on the hotel counter enables the night clerk to answer incoming calls wihout going to the board, the switch-hook in the desk set comprising in this case the common answering key. The popularity of this common-sense arrangement can be readily appreciated, since experience shows that over 95 per cent of all calls from hotel rooms do not result in completed connections, and in such cases it is only necessary for the guest to state his wants since the line lamp reveals his identity. This common answering circuit will no doubt find a wider application than hotel use.

PORTLAND SECTION, A. I. E. E.

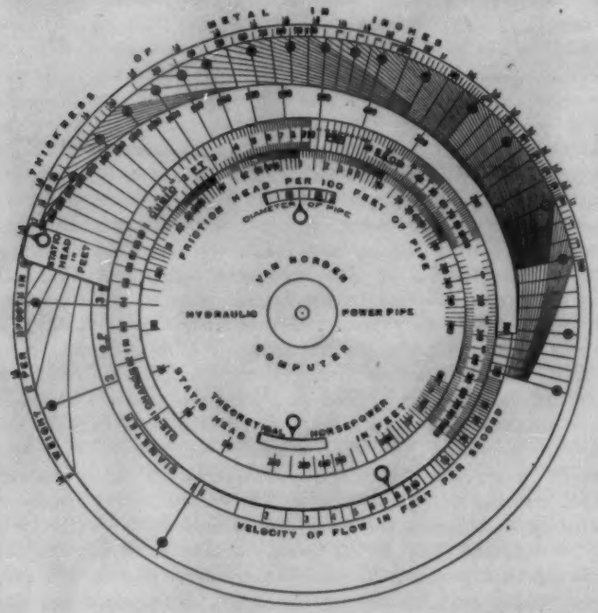
A meeting of the Portland Section of the American Institute of Electrical Engineers was held Tuesday, May 17th, at their assembly hall, Electric building. This was the annual meeting of the section, reports being made and officers for the ensuing year elected. A paper was presented by Mr. J. W. Newell on the "Handling of Telephone Traffic." A report of the San Francisco meeting was made by Mr. Paul Lebenbaum. Personal experiences in early electrical work were given by several of the older members.

PIPE CALCULATOR.

BY RUDOLPH W. VAN NORDEN.

This calculator is designed to quickly and accurately give the size and carrying capacity of long riveted steel pipes. The various functions are represented by logarithmic scales, so arranged, that, with one exception (calculation of the theoretical horsepower in the water), the scales may be placed to show all of the values at once.

There are eight values possible of determination, which can be found when two are known and the third assumed. They are: *volume* of the flow; *friction head* or loss per 100 ft. of pipe; *diameter* of the pipe; *static head* or the fall of the pipe; proper *thickness of metal* for any given head; *weight* per foot of pipe for any given thickness of metal; *velocity* of the flow; *theoretical horsepower* in the flow. These values bear to each other simple algebraic relations, with the exception of the formula for the *friction head*. This is based on the results of a large number of tests made on pipes with riveted seams and an interior lining of asphaltum or similar dip, varying not only in pressure applied, but also in size and length. Any of the friction head formulas



in use could be applied in the place of the one adopted, by changing the small scale for diameter, to conform with the formula.

To facilitate the arrangement of the scales in the computer, two of the functions represented have duplicate scales. These are *diameter* and *static head*.

There are three moving parts, two of them being discs and the third a sector. The stationary part, upon which the moving parts are mounted, has four scales; that for *velocity* of the flow, at the bottom; a scale giving *diameters;* outside of this a scale giving the *weights* of one foot length; and outside of the latter, one giving the various *thicknesses*. The scale giving weights is plotted to conform with a series of curved lines, which cross the lines of the diameter scale at points that arithmetically represent equal weights of unit lengths of pipe.

The sector indicates the proper thickness by means of a pointer. It contains also a scale representing the *static head*, the lines of this scale being terminated by the edge of the sector in such a way that the length of the lines is directly proportional to the head represented by the line. This is for the purpose of selecting the proper line, representing *weight*, and it is done by moving the sector so that the line representing head coincides with that showing *diameter*. The *weight* line intersecting the edge of the sector at this point is the one desired and its value is found by simply following out the line to its scale. These weight lines are all the same curve in respect to the center and could have been obviated by supplying a second sector, having an edge cut to correspond with the lines; it was deemed simpler to draw in the lines.

The larger dial contains a scale of *volume* of the flow in cu. ft. per second. It also contains a second *diameter* scale and a *theoretical horsepower* scale, the latter two appearing through windows in the small dial. A pointer on the large dial shows the *velocity*, when the value for *volume* is set to coincide with that for *diameter* (on the stationary scale).

The small dial contains the *friction head* scale. This is drawn to one-half the size of the *volume* scale and therefore its values represent the squares of those of the former and correspond to the numerator of the empirical equation for flow. A pointer on this dial indicates *diameters* on a scale seen through a window, when the line representing the unit *friction head* is made to coincide with that showing the *volume*. This *diameter* scale is drawn to dimensions bearing a relation to the *volume* scale of the exponent in the denominator of the formula used.

Another scale on the small dial is a duplicate scale to be used in connection with the *volume* scale, to determine the *theoretical horsepower*, which is shown through a window. While all of the other functions may be found by one setting of the calculator, this last computation is entirely separate.

The computer when set will therefore have the lines representing *diameter* (large scale), *static head* (sector), *volume* (large dial), *friction head* (small dial), all in one direct line, while the pointers will be properly directed to the *thickness* (only, of course, for the static head in question), *velocity*, and the edge of the sector will determine the unit *weight* (for the thickness shown).

To determine the *theoretical horsepower*, it is necessary to revolve the small dial until the proper value on its scale of *static head* coincides with that of *volume* on the large dial. The result desired is read directly through the window provided.

In setting the calculator, it may be found that the pointer on the sector shows an intermediate value for thickness. As sheet metal is supplied only in standard thicknesses it will be necessary to move the pointer to the nearest value given, before reading the unit weight.

The scale of *friction head* is carried to 1000 ft. to allow for calculations for the theoretical flow of water from pumps. The pressure required to force a given quantity of water through a given length and size of pipe can be instantly determined by finding the friction head for the total length and adding to it the static head on the pipe. This method does not, however, provide for sharp bends or entrance friction or the efficiency of the pump.

The values given as the proper thickness of metal are plotted on the assumption of an ultimate tensile strength of 50,000 lb. per square inch and a factor of safety of 4½. The tensile strength assumed is somewhat lower than is, as a rule, commercially encountered, but as the strength of riveted joints is somewhat less than the metal itself, the value used is a fair average for practically all conditions.

In calculating the thickness of a pipe, all the values from the bottom to the top, together with their weights, may be rapidly found as soon as the diameter is known. The profile of the pipe should be laid out on cross-section paper; the thickness at the bottom, where the head on the pipe is greatest, is determined, then, always working to the same diameter, move the sector, so that its pointer is placed consecutively at each thickness value and the static head and unit weight noted and plotted on the profile, remembering that any given size starts at the point plotted and runs up the pipe to the next point. After all the points are plotted, the lengths of the various sizes may be directly measured. The length of each section multiplied by the unit weight gives the weight of the section, and the sum of the weights of the sections gives, of course, the total weight of the pipe..

Long cast iron and wood-stave pipes may be calculated for

volume of flow, diameter, velocity of flow and friction head. Friction head formulas for these pipes are somewhat different than the one used for riveted pipe. In the case of cast iron, the computer is approximately correct, only for diameters of 16 in. or over, for smaller diameters the unit friction head values given are too high. In other words, a 10-in. cast iron pipe will have a lower friction loss than the computer would show for that size or for the same head it would carry a greater quantity of water than the riveted pipe. A number of multipliers are given to use with the friction head values, that might be found in the computer, which will give the proper values for cast iron.

Wood pipe has a much lower friction loss than either riveted or cast iron pipe and in figuring a wood pipe, the friction head values found must be multiplied by 0.50 to 0.70, depending on whether the pipe be old or new.

In working the pipe computer, which gives friction losses for units of 100 ft., the relations between these unit values, to the whole pipe line are generally derived by a simple mental calculation. This is sometimes confusing and the diagram is furnished to show these relations graphically.

The following equation is involved:

$$L \times F = f = p \times H, \text{ where,}$$

Co-ordinate Functions
- L = Length of the pipe.
- F = Friction loss per 100 ft. of pipe.
- f = Total friction loss in the pipe.

Co-ordinate Functions
- p = Percentage of the total head lost.
- H = Fall or static head of the pipe.

The first two values are represented in the diagram by the horizontal and vertical lines, reading, respectively, from the left side and the top and must always be associated by reading to or from their intersections.

The last two values are also represented by co-ordinates, reading respectively from the bottom and the right side of the diagram.

The slanting lines tie the two sets of co-ordinates together by joining their intersections, thus making an assembly of all of the values in the equation. Incidentally, they also represent the values of the total friction head or loss.

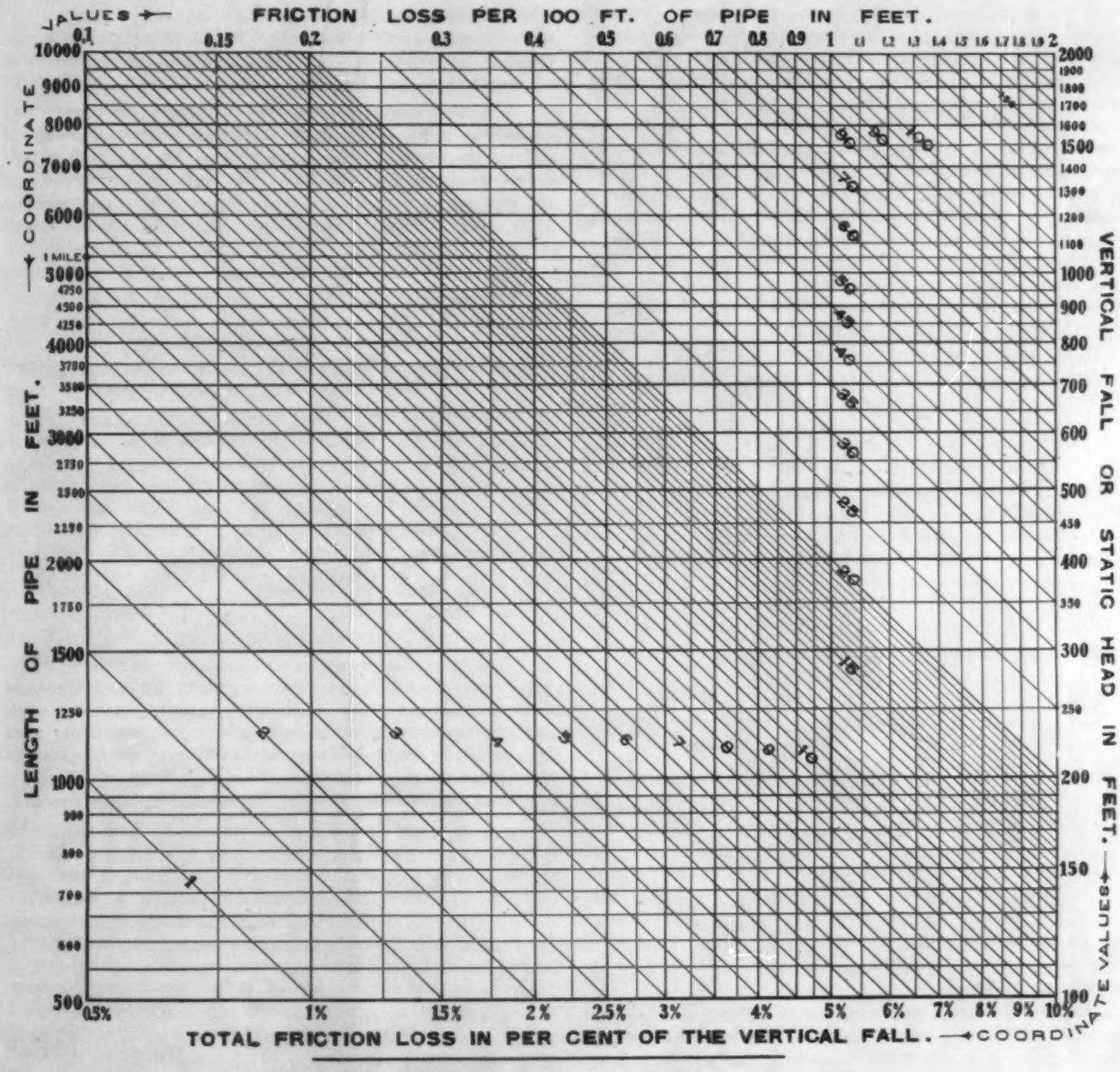

FRICTION LOSS PER 100 FT. OF PIPE IN FEET.
VALUES
COORDINATE
LENGTH OF PIPE IN FEET.
1 MILE
VERTICAL FALL OR STATIC HEAD IN FEET.
VALUES
COORDINATE
TOTAL FRICTION LOSS IN PER CENT OF THE VERTICAL FALL.
SLANTING LINES SHOW TOTAL FRICTION LOSS IN FEET.

Diagram showing relations between unit friction loss and total friction loss for any length and fall of a pipe.

In using the diagram, two values are generally known and the third may be assumed.

Start with any two values which are co-ordinate. Find the point where their co-ordinates intersect. Bearing this point in mind, find the line representing the third value and, starting from the first point already located, follow the intersecting slanting line to where it cuts the line representing the third value. From this new point, the remaining intersecting co-ordinate line represents the fourth value sought. The slanting line which was followed represents the total friction loss in the pipe.

In order to meet all conditions, many more lines would have to be drawn in the diagram. These have been omitted to avoid confusion. Imaginary co-ordinate and slant lines to suit any values may be made by the use of a straight-edge held parallel to the horizontal or vertical or slanting lines, as the case may be.

Example. A pipe has a length of 3000 ft. and a fall of 900 ft.; it is shown by the computer to have a unit friction loss of 0.6 ft. per 100 ft. of length. What is the percentage of the total head lost?

From 3000 ft. on the left and 0.6 ft. on the top, follow their respective horizontal and vertical lines to their intersection; then follow the slanting line, to where it cuts the horizontal line from 900 ft. on the right side. Reading down the vertical line from this second intersection is 2 per cent, which is the answer. The value of the slant line which was used is seen to be 18 ft., which is the total friction loss.

Example. A pipe 4000 ft. long has a fall of 600 ft. The friction loss is assumed to be 5 per cent of the fall. What is the unit friction loss per 100 ft. of pipe?

Locate 600 ft. on the right and 5 per cent at the bottom. From the intersection of the horizontal and vertical lines respectively representing these values, follow the slanting line to where it cuts the horizontal line from 4000 ft. on the left side. From the intersection so formed follow the vertical line to the desired value at the top, which is 0.75 ft. The slant line followed shows the total friction loss to be 30 ft.

In the illustration, the computer is set to work out a specific problem, and following are two examples that will apply to this setting:

Example 1. It is desired to get the dimensions of a pipe which will have a total length of 3000 ft., the total fall being 500 ft. and the volume of the flow being 11 cu. ft. per second. It is desired to have a pipe large enough so that the friction loss will not be over 10 per cent of the total fall.

A glance at the percentage diagram shows that the unit loss per 100 ft. will be between 1.6 and 1.7 ft.

Start with the volume scale on the large dial and locate 11 cu. ft. per second. Turn the small dial until 1.6 on the friction head scale is in line with the first value. Reading through the window, the pointer shows a diameter of 16 in.

Now move the sector until the line showing 500 ft. static head is in line with the 11 cu. ft. on the volume scale and also in line with that showing a diameter of 16 in. on the large diameter scale. The computer is now set; the pointer at the bottom of the large dial shows the velocity of flow to be 8 ft. per second; the pointer on the sector shows the proper thickness where the head is 500 ft., to be 5/32 in. and the curved line starting where the edge of the sector is in contact with the 16-in. diameter line, indicates a unit weight of 30 lb. per foot of finished pipe.

Next, revolve the small dial until the value of 500 ft. in the static head scale thereon is in line with 11 cu. ft. per second on the volume scale and through the window may be read the theoretical horsepower, which is 640. This value must, of course, in order to get the output of a water-wheel, be multiplied by the efficiency of the wheel.

Example 2. There is a quantity of hydraulic-mining pipe which it is desired to use; the diameter is 16 in. and the thickness of the heaviest of it is 5/32 in. There is available 11 second-feet of water (equal to 440 hydraulic-miner's inches or 550 statute-miner's inches). Find the head which may be safely used and the loss by friction which will occur.

Place the pointer of the sector at 5/32 in. In line with 16-in. diameter, the head is shown to be 500 ft. Turn the large dial until 11 cu. ft. is in line with the head and diameter lines. The pointer on the small dial shows the loss per 100 ft. to be 1.6 ft. and the velocity to be 8 ft. per second.

Now that the safe head has been determined, the length of the pipe may be estimated from a knowledge of the ground. If this is found to be 3000 ft., the total friction loss (from the diagram) is seen to be slightly less than 10 per cent.

In working out the pipe problem it may be necessary to make a number of assumptions for either velocity or allowable friction loss to determine the most economical pipe or the one best suited to the conditions, but in any case the computer will be found to be rapid and as accurate as the ordinary slide rule.

NEW CATALOGUES.

Bulletin No. 388, from the National Brake & Electric Company, exhibits different types of air valves for motormen's use.

Bulletin G, from the Lord Electric Company, 213 West Fortieth street, New York, is devoted to Earll Trolley Retrievers and Catchers.

Number Four of "Work Done" by Westinghouse, Church Kerr & Co., shows the wide range of engineering activities for which they are consulting engineers.

Sprague Flexible Steel Armored Hose is illustrated and described in No. 516 from the Sprague Electric Company. This is intended for either compressed air or steam and is especially durable and flexible.

The traffic department of the Spokane & Inland Empire Railroad Company, have issued a beautiful booklet about Hayden Lake, Idaho, on the company's lines. Typographically and pictorially this is an artistic gem.

Westinghouse Electric Fan Motors for 1910 are attractively portrayed in three handsome brochures from the Westinghouse Electric & Manufacturing Company. Folder No. 4100 is devoted to alternating current fan motors. Folder No. 4101 to direct current, and Circular No. 1165 gives more detailed information on both types.

D. & W. Fuse Company, Providence, R. I., have issued a supplement to their Price List No. 12A, covering their latest types of secondary fuse boxes and service switches and transformer and junction cut-outs, for both aerial and subway lines; also large capacity fuses up to 1,000 amperes, which they have never listed before. In circulars 112 and 113 will be found a complete description of the boxes referred to.

TRADE NOTES.

The Western Wireless Equipment Company has recently been appointed the Pacific Coast agents for the Wireless Specialty Apparatus Company of New York. They will control the Coast output of the perikon, pyron and silicon detectors and the 1-P-76 complete receiving sets, that are being used extensively by the navy to prevent interference. The specialties of the Eastern concern will be used in all of the equipments of the Western Wireless Equipment Company.

The Ohio Brass Company of Mansfield, Ohio, announces that it recently purchased a controlling interest in the insulator pottery at Barberton, which for the past two years has been making the O-B Hi-Tension porcelain insulators sold exclusively by it. Active management of the insulator pottery has been taken over by the officers of The Ohio Brass Company, and under the new arrangement the company, with Mr. G. A. Mead, previously chief Engineer of The Ohio Brass Company, in active charge at pottery, expects to put into effect a system that will increase the rate of production materially, thus keeping pace with the great amount of business being received. All orders and inquiries will be handled from the main office of The Ohio Brass Company at Mansfield, Ohio, as heretofore.

NEWS NOTES

INCORPORATIONS.

CONNELL, WASH.—The Connell-Kahlotus Telephone Company has been incorporated for $2,000 by E. F. Redd.

SALTESE, MONT.—The Saltese Electric Light & Water Company has been incorporated for $10,000 by H. E. Rogers.

STANWOOD, WASH.—The Stanwood Light & Power Company was incorporated recently with L. F. Query as trustee.

SAN FRANCISCO, CAL.—The Central Power Company has been incorporated by J. J. Lermen, S. D. Woods and R. W. Dennis, with a capital stock of $50,000.

SAN FRANCISCO, CAL.—The Pacific Power Company has been incorporated by G. E. Anderson, G. W. Hendry and James McNab, with a capital stock of $1,000,000.

SANTA FE, N. M.—Incorporated: The Cimarron Water Company, with a captial of $60,000. The directors are: G. H. Webster and W. C. Hoffman of Cimarron and W. W. Studley of Raton.

SAN MATEO, CAL.—The rumor that the San Mateo Water Company had taken over the holdings of the Burlingame Water Company was practically authenticated when the Peninsular Water Company filed articles of incorporation in Redwood City. The incorporators of the new company are the same as of the San Mateo Water Company—Joseph Levy, Wm. F. Turbull, H. N. Royden, J. A. Foster and Chas. N. Kirbride. The capital of the new corporation is $1,000,000.

ASOTIN, WASH.—Articles of incorporation have been filed with the County Auditor for the Clarkston Irrigation Association, with a capital stock of $9,000, with the following stockholders: Geo. W. Balley (trustee), L. K. Alderson, C. Evans, F. E. Brown, E. Winders, W. F. Jones and C. McNary. A second article has been filed by the same stockholders, this company to be known as the Grande Ronde Power Company, with a capital stock of $1,000,000. The company will derive electric power enough at the mouth of the Grande Ronde River to furnish power to electric railways and other use.

TRANSMISSION.

LONG BEACH, CAL.—The Mercerea Construction Company has begun driving piles for the construction of the $2,000,000 Edison power plant on the harbor west of the drawbridge.

PHOENIX, ARIZ.—Los Angeles and Eastern people have organized a company, with a capital of $2,000,000, to build a dam at Striped Canyon, near the confluence of the Big Sandy and Santa Maria creeks. It is estimated that this dam will primarily create more than 3,000 electric horsepower, which will be carried to various mining camps in Mohave and Yuma counties.

ALAMEDA, CAL.—The city of Alameda may close down the municipal plant in the day time and get a supply of current from the Great Western Power Company, as the city electric commission declares the municipal plant is operated at a loss in day time. Mayor Noy states that if current was purchased from the power company it would in no way do away with the municipal plant, as the current during the night would be supplied by the city plant.

BOISE, IDAHO.—Capitalists associated with the Hill interests will build a power transmission plant on the South Fork of the Clearwater River, over five miles from the town of Grangeville. Walter Hovey Hill, the engineer who is handling the proposition, has stated to the Hill interests that the proposed plant could generate 5,000 horsepower at that site to start with, and that additional plants can be built on other sites when the additional power is needed.

NEVADA CITY, CAL.—The Northern Water and Power Company, which owns a system of storage reservoirs in the mountains north of this city, will commence operations upon the Sawmill Flat reservoir. It is the intention of the company to raise this dam to increase its storage capacity. It is hoped to complete the work during the present season. The Middle Yuba Hydro-Electric Power Company also expects to begin operations shortly on their power scheme on the Middle Yuba below Graniteville. Flumes, ditches, reservoirs and a power-house will be constructed. It is the aim of the company to supply Alleghany with light and power.

QUINCY, CAL.—H. O. Lague, engineer and manager of the Feather River Power and Development Company, is in Quincy on business connected with his company, which is engaged in developing a hydro-electric power proposition on the Middle Fork of Feather River, below Nelson Point. The project planned includes the erection of three plants capable of producing, under natural conditions and without the assistance of storage reservoirs, a total of about 5,000 hp. It is estimated that the total drop to which the volume of water in the Middle Fork would be subjected in its course through the chain of plants would be 3,000 feet. The three points of diversion proposed are at Nelson Point, the mouth of the Onion Valley Creek, and at or near the mouth of the South Branch.

TRANSPORTATION.

LOS ANGELES, CAL.—The City Council has granted the petition of Robt. Marsh for a street railway franchise on Thirty-ninth street, from Vermont avenue to Western avenue.

BAKERSFIELD, CAL.—The Power Transit & Light Company has made application to the Board of Trustees for a fifty-year franchise for a single or double-track railroad in the city of Bakersfield.

CARSON CITY, NEV.—Ogden Mills, president of the Virginia and Truckee Railroad, who recently completed an inspection of the Virginia and Truckee Road, states that the work of extending the line to Bridgeport, Cal., will not be started this year.

COLUSA, CAL.—The Northern Electric Railway Company has filed a certified copy of its articles of incorporation with the County Clerk of Colusa County. These papers give the company power to build an electric road from Marysville to Colusa, a distance of thirty miles.

ALBANY, CAL.—G. W. McDowell, right-of-way agent; G. F. Nevans, traffic manager; H. Allen, attorney, and J. F. Richardson, civil engineer, representing the Oregon Electric, have applied to the City Council of Albany for a 25-year franchise for the extension of the line through Albany. The road will be in actual construction within two years.

LOS ANGELES, CAL.—Gen. M. H. Sherman and E. P. Clark no longer have their minority interest in the Los Angeles Pacific Railway, their holdings having been taken over by the Southern Pacific Railroad, which corporation has had a controlling interest in the property since 1905. Although the property has been under the nominal direction of Sherman and Clark since last November, when their holdings were taken over by the majority interest, the Southern Pacific has maintained a close supervision, and no new expenditures have been made without the authority of the Southern Pacific.

PROFESSIONAL DIRECTORY

F. G. Baum & Co.
ENGINEERS and CONSTRUCTORS
Complete Hydro-Electric Power Developments
Electric Power Transmission Systems
1406-8 Chronicle Bldg. San Francisco, Cal.

Hunt, Mirk & Co., Inc.
ENGINEERS and CONTRACTORS
for complete Steam-Electric Power Plants.
141 Second St. San Francisco

Sanderson & Porter
ENGINEERS AND CONTRACTORS
Reports, Designs, Construction, Management.
Hydro-Electric Developments.
Railway, Light and Power Properties.
New York San Francisco

H. M. Byllesby & Co.
ENGINEERS
218 LaSalle Street, Chicago, Ill.
Portland, Oregon Mobile, Alabama
Oklahoma City, Oklahoma

D. C. Jackson, C. E. Wm. B. Jackson, M. E.
D. C. and Wm. B. Jackson
Members American Institute of Electrical Engineers, American Society of Mechanical Engineers, American Society of Civil Engineers.
ENGINEERS EXPERTS
508 Commercial National Bank Bldg., Chicago, Ill.

E. F. Scattergood
CONSULTING ENGINEER
1133-1134 Central Building
Los Angeles, California

Supervision of Operation and Installations for Fuel Economy — Combustion Tests
R. F. Chevalier
CONSULTING ENGINEER
High Temperature Measurements
Fuel Analysis (Oil and Coal)
Phone Alameda 1389 — Office and Laboratory, 930 Lincoln Ave., Alameda, Cal.

A. H. Koebig
CONSULTING ENGINEER
Hydro-Electric Plants
Irrigation Plants
902-905 Broadway Central Bldg.
Los Angeles, Cal.

Smith, Emery & Co.
INSPECTING AND TESTING ENGINEERS AND CHEMISTS
651 Howard Street San Francisco

C. L. Cory
CONSULTING ENGINEER
801-802-803-804 Union Trust Bldg.
San Francisco

Manifold & Poole
CONSULTING AND SUPERVISING ENGINEERS
Electrical, Hydraulic, Mechanical, Steam, Civil, Irrigation
732-733 Central Bldg.
Los Angeles, Cal.

Spalding, Sloan & Robson
Consulting and Supervising Engineers
Electrical, Hydraulic
Mechanical, Steam
Civil, Mining
802-3-4 Union Trust Bldg.
San Francisco, California

John S. Eastwood, C. E.
Designer of dams of the
EASTWOOD MULTIPLE ARCH TYPE
Suitable for any height or site.
Cheaper than earth dams.
Stronger than solid masonry.
Builder of the HUME LAKE DAM.
Box 663 FRESNO, CAL.

Samuel G. McMeen Kempster B. Miller
McMeen & Miller
ELECTRICAL ENGINEERS
PATENT EXPERTS
Special Attention to Telephony
1454 Monadnock Block CHICAGO
333 Grant Avenue SAN FRANCISCO

Rudolph W. Van Norden
CONSULTING ENGINEER
Member American Institute of Electrical Engineers
Member American Society of Civil Engineers
304-306 Union Trust Bldg.
San Francisco
Electricity, Hydraulics, Power Development
Reports and Evaluations

F. C. Finkle
CONSULTING ENGINEER
Specialties:
Hydro-Electric Power Plants
Irrigation and Domestic Water Supplies
628½ South Spring Street
Los Angeles, Cal.

Charles T. Phillips
ELECTRICAL ENGINEER
Lighting, Railway, Industrial and Power Installations
422 Crocker Bldg. San Francisco

G. F. Wakefield
SURVEYOR AND ENGINEER
Hydro-Electric Power Development
Porter Building San Jose, Cal

A. M. Hunt
MEM. AM. SOC. C. E.
MEM. AM. SOC. M. E.
MEM. AM. I. E. E.
Union Trust Bldg. San Francisco

Phone Douglas 5877 Office, 82 Second St.
L. St. D. Roylance
Consulting and Constructing Electrical and Mechanical Engineer
Plans, Specifications and Estimates for Electric Light and Power Plants. Electrical, Mechanical and Patent Office Drawings. Tests of Dynamos, Motors, Boilers, Steam and Gas Engines.

J. G. White & Company, Inc.
ENGINEERS CONTRACTORS
San Francisco Office
Alaska Commercial Building
43 Exchange Place, New York City